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BIOCHEMISTRY

UDC: 614.7-078:[579:574.4

MICROORGANISMS USED TO MONITOR ENVIRONMENTAL POLLUTION

Moscow GIGIYENA I SANITARIYA in Russian No 11, Nov 81 (manuscript received 21 May 81) pp 11-13

[Article by G. A. Bagdasar'yan and K. V. Geniatulin, Institute of General and Communal Hygiene imeni A. N. Sysin, USSR Academy of Medical Sciences; and Scientific Research Institute of Physicotechnical and Radio Engineering Measurements, Kryukovo Station]

[Text] Methods based on the capacity of living organisms to react to exogenous factors, including environmental pollution factors, are acquiring increasing importance in monitoring the environment, particularly when it is difficult to measure a pollutant by existing equipment.

At present, there is a considerable amount of data in the literature concerning the feasibility of using bioorganisms differing in level of organization (plants, hydrobionts, microorganisms and others) as sensitive indicators of pollution (V. D. Fedorov).

By virtue of the distinctions inherent in microorganisms (as well as elements in common with all other living organisms), they could play a unique role as sensitive indicators of pollutants.

Since the main tasks for sanitary microbiology at the present time are to study the influence of biological pollution on public health and processes of self-purification, as well as hygienic regulation thereof, continued work on methods of labeling biological pollution when both physical and chemical factors are involved by means of microorganisms that are the most sensitive to pollution would make a new contribution to monitoring the state of the environment.

Consideration of only two of the distinctions of microorganisms--metabolic and genetic changes under the influence of pollution--proves the need to pursue research in order to establish criteria for selection of microorganisms to be used as biological indicators of pollution.

Nutrition is a most important aspect of metabolism. The vast majority of microorganisms can assimilate organic matter. Hence it is apparent that organic environmental pollutants (petroleum products, coal and others), which are toxic to many other living organisms, serve as a source of nutrition in certain concentrations for microorganisms. The process of mineralization of these chemical pollutants and rate of mineralization may indicate that these organic pollutants are present in environmental objects.

On the example of purification of liquid sewage by means of active silt, the main composition of which is determined by different microbiocenoses, one can see how the qualitative and quantitative composition of silt changes as purification proceeds, how the number and species of microorganisms change. These two factors could play the role of pollution indicators.

There is stimulation or depression of different groups of microorganisms, depending on the type of pollutant and its concentration. Experimental studies have shown substances differing in chemical action have different effects on various microorganism species (G. A. Bagdasar'yan et al., 1980). It has been established that the reactions of microorganisms depend, on the one hand, on the nature of agents to which they are exposed (for example, heavy metals and surfactants) and, on the other hand, on biological distinctions of the microorganisms.

This must be taken into consideration in choosing microorganisms as pollutant indicators. Consideration of heredity of microorganisms and its variability in different generations under the influence of environmental factors (biological, chemical, physical) may also be a convincing argument for the desirability of using microorganisms as biological objects that are the most sensitive to environmental pollution factors.

Bacteria and cell cultures are already being used as test systems to examine the mutagenic activity of different pollutants. For example, salmonella was chosen as the test system to study the mutagenic potential of polycyclic aromatic hydrocarbons (Ames et al.).

A virus-cell system has been used to determine the biological effects of heavy metals (T. P. Shvetsova et al.). Saccharomycetes have proven to be a convenient object for mutagenicity testing (I. A. Zakharov).

As compared to other microorganisms, little has been done with regard to using viruses as pollutant indicators. But apparently, some of them could also be selected for this purpose. This is confirmed by the studies dealing with demonstration of mutagenicity of heavy metal salts (T. P. Shvetsova et al.). It was established that viral titers in the hemagglutination reaction were higher in the presence of cadmium salts than without them. There are data (G. A. Bagdasar'yan et al., 1977) indicative of high resistance of viruses to adverse environmental factors.

Use of microorganisms to monitor environmental pollution by means of microbiological test systems to evaluate such pollution would be the further development of methodological studies in sanitary microbiology. The range of sufficiently tested and reliable microorganisms serving as indicators of environmental pollution by pathogenic bacteria and viruses could be enlarged by other species of microorganisms that are indicators of pollution of environmental objects. This will require the elaboration of criteria for selecting the microorganisms that are the most sensitive to a given pollutant.

Thus, the approach we propose combines traditional methods of sanitary microbiology and indication of environmental pollution by means of developing the appropriate microorganisms among the most representative sensitive species.

The problem of choice of microorganisms for development of test systems to assess environmental pollution requires special metrological and mathematical implementation.

Standardization and metrology of measurements constitute one of the main problems of microbiological monitoring of the environment. Solution thereof involves development of standardized and certified methods of taking readings with the required reproducibility and accuracy.

It should be noted that metrological implementation of measurements in biomedical research and, consequently, in the area of microbiological monitoring of the environment constitutes a basically new problem. Specialists in different fields (hygienists, metrologists, mathematicians and others) must work closely together to solve it, as had already been discussed several years ago (V. V. Boytsov).

Development of approaches to the solution of this problem that would provide the necessary accuracy of measuring changes in the state of macroorganisms [sic] under the influence of pollution would also help solve the problem of demonstrating pollution using the reaction to it of sensitive parameters of vital functions of test microorganisms. The choice of sensitive microorganisms is closely linked to observation of changes in a specific set of their parameters under the influence of pollution. Classification followed by optimum selection of the most sensitive (i.e., those showing the most marked changes) parameters and evaluation thereof should be based on statistical measurement theory.

The problem of the metrological aspect of biomedical and, consequently, sanitary and hygienic studies would stimulate further development of methods of multidimensional mathematical analysis in this field. The capabilities of only one of the parts of analysis--pattern recognition theory--could solve such problems as separating the microorganisms under study into classes differing in sensitivity, evaluation of the quality of such separation (metrological problem), isolation of the set of the most important features (parameters) for indicator purposes, evaluation of informative value of a feature, evaluation of sufficiency and reliability of features contained in the set, etc. Let us also mention the problem of constructing a classifier. It is important for it to make it possible to minimize the probability of classification error, which is a key parameter. We refer to the gauge of divisibility of classes (microorganisms).

Use of the pattern recognition method involves the use of computers, since large volume calculating procedures are required to run the appropriate algorithms. To sum up the problem of monitoring the state of environmental objects by means of microbiological tests, it can be concluded that development of such tests involves improvement of accuracy and reliability of readings, use of the most efficient mathematical methods to choose test systems of microorganisms and parameters thereof for demonstration of pollutants and processing measurement results.

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10,657
CSO: 1840/109

UDC: 576.858.6

MOLECULAR CLONING OF DNA FRAGMENTS HOMOLOGOUS WITH MURINE SARCOMA VIRUS ONCOGEN FROM COLLECTION OF TRANSFORMED CELL GENES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 6, Dec 81
(manuscript received 10 Jul 81) pp 1456-1459

ZABAROVSKIY, Ye. R., PRASOLOV, V. S., CHUMAKOV, I. M. and KISELEV, L. L.,
Institute of Molecular Biology, USSR Academy of Sciences, Moscow

[Abstract] The objective was to use genetic engineering to obtain a collection of genes of mouse cells transformed by Moloney's sarcoma virus (MSV) and to find clones in such a collection with DNA areas homologous to the genes of MSV sarc (or src, mouse cell proviral oncogen introduced by MSV). Haron 4A lambda phage was used to produce the gene collection, phage DNA was separated with EcoRI restrictase and terminal fragments separated from internal ones. DNA of mouse cells transformed by MSV was split with EcoRI restrictase at 37° for 2 hr. Recombinant DNA was stacked in vitro in phage protein at the rate of 10^5-10^6 plaque-producing units/μg recombinant DNA. A previously produced recombinant pI126 plasmid containing part of the MSV genome was used to search for clones. The isolated group of clones contained nucleotide sequences related both to the oncogen and MSV genome, suggesting that it also contains MSV provirus. This was checked by mapping several clones and comparing the maps to the physical maps of provirus and protosarc (cellular oncogen present in mouse cell genome) to surrounding DNA sequences that are known. Many more differences than similarities were demonstrated. The nature of segments of mouse genome homologous to MSV oncogen and to retrovirus-specific nucleotide sequences is discussed. It would appear that pseudogenomes were discovered here that transformed retroviruses after losing active functions, like pseudogenes, due to alteration of structure and localization. Further studies of these DNA fragments are needed. Figures 3; references 12: 2 Russian, 10 Western.
[83-10,657]

UDC: 615.28:547.818.6

SYNTHESIS, ANTIBACTERIAL AND ANTIPHAGE ACTIVITY OF POLYSUBSTITUTED THIAPYRILIUM PERCHLORATES

Moscow KHIMIKO-FARMATSEVTICHESKIY ZHURNAL in Russian Vol 15, No 11, Nov 81 (manuscript received 23 Feb 81) pp 38-40

KHARCHENKO, V. G., KOZHEVNIKOVA, N. I., KULIKOVA, L. K. and VORONINA, N. V., Saratov University imeni N. G. Chernyshevskiy

[Abstract] This is a continuation of studies of effects of structure of thiapyrilium on biological activity, involving synthesis of pentasubstituted and tetrasubstituted perchlorates thereof; these compounds were synthesized by addition of 1.3 mℓ 70% perchloric acid to 1 g thiapyran I in 20 mℓ glacial acetic acid filtering off the precipitate after 48 h. Serial dilutions in Hottinger broth of the synthesized compounds were tested for activity against Staphylococcus aureus 209, E. coli 675, Proteus vulgaris 38, Pseudomonas aeruginosa 165 and Candida albicans 39, and antiphage activity was tested on DNA-containing phage. Characteristics, intrinsic bands of thiapyrilium cation absorption in infrared spectra, antibacterial and antiphage activity of the thiapyrilium salts are tabulated. It is concluded that the class of thiapyrilium salts is a promising subject of research for the purpose of synthesizing new antiviral and antibacterial agents. References: 3 Russian. [80-10,657]

UDC: 615.2/.3.074:543.42.062]:681.31

INFORMATION RETRIEVAL SYSTEM BASED ON 580 SPECTROPHOTOMETER AND 6/16 MINICOMPUTER FOR IDENTIFICATION OF SUBSTANCES ACCORDING TO THEIR OSCILLATION SPECTRA

Moscow KHIMIKO-FARMATSEVTICHESKIY ZHURNAL in Russian Vol 15, No 11, Nov 81 (manuscript received 30 Dec 80) pp 102-107

VINOKUROV, V. G., KISELEV, S. A., TROITSKAYA, V. S. and ZAVALISHINA, I. V., Institute of Pharmacology, USSR Academy of Medical Sciences, Moscow

[Abstract] The 580 spectrophotometer (Perkin-Elmer Company) and linked minicomputer 6/16 (Interdata Company) were used to build an information retrieval system for the purpose of speeding up the process of identifying compounds, which are usually identified by their oscillation spectra, and specifically infrared spectra, that otherwise is a time-consuming process. A flowchart of the proposed system is illustrated, and it consists of a local computer system, computer catalogue of infrared spectra, operating program in the

FORTRAN-5 language, in addition to the spectrophotometer and minicomputer. The operating routine consists of several subroutines, and it forms a file of spectra, as well as retrieves and selects from this file the one that is the best match, on the basis of infrared spectrum frequencies, or frequencies and relative intensities of all bands. It is also possible to input a spectrum in a coded form from another instrument. The subroutines are: INPUT, EXTERN (input of spectra measured on other types of spectrophotometers), PEAK (peaks), SELECT, OUTPUT, FIND, STATUS, CNTENT, RETRVE and COPY; the aggregate programs consist of 1026 operators and have a memory of 52 Kbytes. Method of forming data bank and catalogue of infrared spectra is described, and examples of printouts are illustrated. The retrieval parameters to be used to identify substances are listed and described. A trial of this system showed that it can speed up the identification process in some cases. Figures 3; references: 4 Russian.
[80-10,657]

UDC: 581.19:547.94

BIOSYNTHESIS OF 'UNUSUAL' ERGOALKALOIDS BY FUNGUS PENICILLIUM AURANTIO-VIRENS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 1, Sep 81
(manuscript received 21 Apr 81) pp 230-233

KOZLOVSKIY, A. G., SOLOV'YEVA, T. F., SAKHAROVSKIY, V. G. and ADANIN, V. M.,
Institute of Biochemistry and Physiology of Microorganisms,
USSR Academy of Sciences, Pushchino, Moscow Oblast

[Abstract] The P. aurantio virens VKM F-229 was obtained from the All-Union Collection of Microorganisms and in addition to previously described methods of cultivating it, isolating total alkaloid mixture, extraction was performed with a chloroform and isobutanol (4:1) mixture yielding a total of 234 mg dry extract. Chromatography showed that there were 1 major and 2 minor components in the extract, the former being extracted at alkaline pH and the latter at acid values. Chromatography, ultraviolet spectra and mass spectra parameters revealed that the major component has tne properties of a typical base, and it was named aurantioclavine; one of the minor components was identified as indolyl-3-acetic acid and the other as clavicipitic acid. The latter showed no change in dynamics of biosynthesis as a function of culture age, whereas aurantioclavine biosynthesis starts and reaches a maximum at the stationary phase. Addition of ethionine to P. aurantio virens culture resulted in negligible production of clavicipitic acid, but active synthesis of aurantioclavine, which is apparently the precursor of the former. It was demonstrated that P. aurantio virens F-229 has the specific capacity to

produce aurantioclavine and clavicipitic acid as metabolites, and the proposed route of biosynthesis of aurantioclavine is: tryptophan → 4-γ, γ-dimethylallyl tryptophan → clavicipitic acid → aurantioclavine. Figures 2; references 5: 1 Russian, 4 Western.
[81-10,657]

UDC: 579.858

BUNYAVIRUSES

Moscow USPEKHI SOVREMENNOY BIOLOGII in Russian Vol 92, No 5, Sep-Oct 81
pp 228-242

L'VOV, D. K., Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences, Moscow

[Abstract] Viruses of the family Bunyaviridae, just recently distinguished as an independent family, are described. All representatives of the family are carried by sensitive vertebrates by biological transmission through blood-sucking arthropod vectors. The family includes 4 genera: Bunyavirus, Phlebovirus, Nairovirus and Uukuvirus. The chemical composition of the virions is described, as well as certain physical-chemical properties, morphology and morphogenesis. Accumulation of viral protein occurs in the cytoplasm, particularly in the cytoplasmic membranes. Actinomycin D in concentrations inhibiting RNA synthesis in the host cells fails to prevent the early stages of viral replication in cell cultures. Genetic interactions are described. Some 100 bunyaviruses are known in the continent of America, 20 of which are significant in human pathology, generally producing fevers. Limited outbreaks of encephalitis-like disease have been associated with viruses of the California group. Massive outbreaks of benign fever disease, infecting up to 20,000 persons, have been associated with the oropush virus. Worldwide ecology and epidemiology of the Bunyaviridae are described. The variation in clinical course of diseases is so great that only laboratory methods can be used for definitive diagnosis. The complement fixation reaction is primarily used for diagnosis of acute cases. References 74: 4 Russian, 70 Western.
[116-6508]

UDC 615.281

PRODUCTION AND TRANSLATION OF MESSENGER RNA FOR HUMAN IMMUNE INTERFERON

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 4, Dec 81
(manuscript received 22 May 81) pp 997-1000

NOVOKHATSKIY, A. S., TIKHONENKO, T. I., YERSHOV, F. I., ASPETOV, R. D.,
KHIL'KO, S. N., SOKOLOVA, T. M., LYAKH, L. A. and NOSIK, D. N.,
Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Sciences, Moscow

[Abstract] Experiments designed to stimulate the production of immune interferon in human lymphocyte cultures showed that the highest titers were obtained when a suspension of stimulated cells was treated with staphylococcus enterotoxin A (SEA) and incubated for 72 hrs in roller bottles. Physical-chemical and biological properties of this product showed that this synthetic interferon was not neutralized with antisera to α- and β-human interferons. It was inactivated at pH 2.0. A conclusion was made that this was human γ-interferon. It was further shown that in the SEA-induced human lymphocytes there is formed m-RNA capable of being translated in a noncellular system forming a product with antiviral activity in human fibroblast cultures. References 13: 2 Russian, 11 Western.
[113-7813]

UDC: 547.962.02

ISOLATION AND QUATERNARY STRUCTURE OF NEUROTOXIN FROM VENOM OF LATRODECTUS TREDECIMGUTTATUS SPIDER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 2, Jan 82
(manuscript received 27 May 81) pp 485-488

SALIKHOV, Sh. I., TASHMUKHAMEDOV, M. S., ADYLBEKOV, M. T., KORNEYEV, A. S.
and SADYKOV, A. S., academician, Institute of Bioorganic Chemistry,
Uzbek Academy of Sciences, Tashkent

[Abstract] Physicochemical properties and quaternary structure were studied of the protein neurotoxin isolated from the venom of the spider Latrodectus tredecimguttatus inhabiting Central Asia, using the following reagents and sorbents for chromatography: Sephadex, biogel, DEAE-cellulose, polyacrylamide gel film, reagents for disk electrophoresis with sodium dodecylsulfate and dansyl chloride, as well as ammonium sulfate for separation of whole venom, showing that the active fractions were precipitated with 25-60% saturation. Gel chromatography of these active fractions demonstrated three of them, one

of which was toxic. It was demonstrated that the toxin is homogeneous and that its molecule has a quaternary structure. Amino acid composition was the same in all forms of the toxin indicating the identity of all protomers contained in its molecule and suggesting that it is an oligomeric protein. At neutral and mildly alkaline pH the toxin is a biologically-active dimer and tetramer, which dissociates into inactive monomer at low pH in the presence of detergent. Amino acids, number of radicals are tabulated for this neurotoxin, as determined by these and other authors. Myosin, phosphorylase a, toxin, bovine serum albumin, catalase, ovalbumin, aldolase and chymotrypsin served as marker proteins for determination of molecular weight of spider venom neuroton by electrophoresis. Figures 4; references 15: 1 Russian, 14 Western.
[97-10,657]

UDC: 577.1

CLONING AND RESTRICTION MAPPING OF MAXICIRCULAR MOLECULE FRAGMENT OF CRITHIDIA OCNOPELTI KINETOPLAST DNA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 5, Dec 81 (manuscript received 19 Jun 81) pp 1271-1273

MASLOV, D. A., ENTELIS, N. S., KOLESNIKOV, A. A., ZAYTSEVA, G. N., KUZ'MIN, N. P. and FODOR, I., Moscow State University imeni M. V. Lomonosov

[Abstract] The existence of kinetoplast (mitochondrial) DNA (kpDNA) in trypanosomes, in the form of an associate of several thousand catenary circular molecules prompted research on its evolution, role and organization. The circular molecules consist of minirings and maxirings and minicircular molecules are the main constituent of the kpDNA associate. It is assumed that the maxirings constitute the mitochondrial genome of these protozoans, and molecular cloning was used to verify this, using BamHI restrictase for isolation of maxicircular fragments. BgIII, BspI, EcoRI and Hind III restrictases were also used for isolated and joint segregation and yielded the restriction map of plasmic pCo52 contained in the clone selected for more comprehensive study. The cloned DNA revealed four zones after electrophoresis, three formed by high molecular fragments and the fourth of fragments 0.45 kilobase pairs (thousands of base pairs) in size, as well as several larger ones, i.e., there was demonstration of five segregation sites for EcoRI, 0.45 kilobase pairs apart from one another. The findings suggest the existence of a segment consisting of a sequence that recurs many times in the maxicircular molecule. Figures 2; references 10: 4 Russian, 6 Western.
[99-10,657]

UDC: 577.1

LOCALIZATION OF GENES OF TWO RNA'S ON MAXICIRCULAR MOLECULE OF KINETOPLAST DNA OF CRITHIDIA ONCOPELTI ZOOFLAGELLATE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 5, Dec 81
(manuscript received 19 Jun 81) pp 1274-1276

METT, I. L., KUZ'MIN, Ye. V. and ZAYTSEVA, G. N.,
Moscow State University imeni M. V. Lomonosov

[Abstract] A search was made of transcripts of the cloned fragment of maxicircular DNA and localization of their genes. Hot phenol was used to extract RNA, then electrophoresis for separation in agarose with urea, in citrate buffer. RNA was eluted and purified by chromatography on CF-11 cellulose, and pancreatic deoxiribonuclease used for hydrolysis of calf thymus DNA as primer for synthesis of complementary DNA from RNA. Hybridization of kinetoplast RNA yielded plasmid pCo52 with two RNA components, 14.5 and 10 S. The sites of dissociation of HinfI endonuclease were mapped. The 14.5 S and 10 S RNA genes were definitely localized, being close to one another mainly in the 2.2 kilobase pair HinfI fragment, but more accurate pinpointing can only be done after comprehensive mapping of maxicircular DNA segments. Work is continuing on the exact location of the gene or genes of 22 RNA and determination of the functions of all three mentioned RNA's by obtaining recombinant plasmids containing the part of the DNA not contained in pCo52. Figures 3; references 12: 2 Russian, 10 Western.
[99-10,657]

UDC: 575.173

PLASMID USED TO TRANSFORM BACILLUS THURINGIENSIS PROTOPLASTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 1, Jan 82
(manuscript received 29 Jun 81) pp 226-228

AZIZBEKYAN, R.R., BELYKH, R. A. and STEPANOVA, T. V., All-Union Scientific Research Institute of Genetics and Breeding of Industrial Microorganisms, Moscow

[Abstract] The pC194 plasmid which determines chloramphenicol resistance was used to demonstrate that Bac. thuringiensis protoplasts can be transformed. Bac. thuringiensis var. galleriae 38 Thi Nic Gua $Str^r Rif^r$, isolated by the authors and containing no plasmids served as the recipient; its photoplasts were obtained by treatment with lysozyme in the presence of sodium salt of

EDTA, resulting in 97.5-99.99% cells in the protoplasts. Plasmid DNA was isolated from Bac. subtilis thr 364(pC194) and used for transforming the protoplasts. The transformants did not differ from the initial strain in either sensitivity to phages or phenotype--S colonies, as well as growth factor requirements, resistance to rifampicin and streptomycin. It was demonstrated that the plasmids in the transformants determine chloramphenicol resistance by using fractions thereof to transform protoplasts of the same recipient strain, as well as testing with plasmid DNA isolated from Bac. subtilis 364(pC194). Incidence of transformation was a function of protoplast formation. The findings indicate that the pC194 plasmid can be used as a vector for molecular cloning in B. thuringiensis. Figures 1; references 12: 3 Russian, 9 Western.
[100-10,657]

UDC: 576.858.25

CLONING AND RESTRICTION ANALYSIS OF HEPATITIS B VIRUS GENOME

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 1, Jan 82
(manuscript received 16 Jan 81) pp 229-232

DRYNOV, I. D., VYAZOV, S. O., NOSIKOV, V. V., URYVAYEV, L. V., ANAN'YEV, V. A. and ZHDANOV, V. M., academician of the USSR Academy of Medical Sciences, Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences, Moscow; and Institute of Molecular Biology, USSR Academy of Sciences, Moscow

[Abstract] This study was motivated by the fact that there are few hosts for hepatitis B virus and difficulty in cultivating it, while viral material is needed to produce vaccines. Viral particles were obtained from the plasma of patients suffering from type B hepatitis. Their DNA was changed to a double-strand state by endogenous DNA polymerase and isolated by the phenol method. It yielded a band of material with molecular mass of about 2.0 megadalton. Hepatitis B viral DNA and pBR325 DNA were treated with EcoRI and ligated with bacteriophage T4 DNA ligase, then added to E. coli K-802 cells cultured in agar containing ampicillin. Chloramphenicol and ampicillin resistant clones constituted 87%, and the plasmids of the former type were isolated, treated with EcoRI and analyzed by electrophoresis. Clones were selected on the basis of plasmid size. Inserts in pBR322 plasmid were identified as corresponding to the complete genome of hepatitis B virus in molecular weight. This plasmid was submitted to restriction analysis using BglII, XbaI and BamHI restrictases. It was demonstrated that the entire genome of the virus under study can be cloned, and its DNA can be produced in the needed quantities for further work. Figures 1; references: 8 Russian.
[100-10,657]

MONOGRAPH ON NEW DIRECTION OF CHEMISTRY AND BIOLOGY OF PEPTIDE AND PROTEIN BIOREGULATORS REVIEWED

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSSR in Russian No 1, Jan 82 pp 137-138

[Review by V. Ivanov and A. Miroshnikov of book "Struktura i funktsii nizkomolekulyarnykh peptidov" [Structure and Function of Low Molecular Peptides], by G. I. Chipens et al., Riga, Izdatel'stvo "Zinatne", 1980, 327 pages]

[Text] Peptide-protein bioregulators (hormones, kinins, releasing factors, neuropeptides and others) occupy a central place in the system of controlling biochemical and physiological processes in living organisms. The study of their structural and functional organization and mechanism of action is important both to gain understanding of the main bioregulatory processes and transfer of information on the molecular level, as well as for controlled synthesis of new analogues of native compounds in order to develop potent agents to be used on a living organism (drugs, diagnostic products for different diseases, growth and productivity stimulators for the livestock industry, etc.).

Chemical modification followed by investigation of biological activity of the obtained compounds is one of the ways of studying the mechanism of action of peptides and proteins in bioorganic chemistry. For this purpose, several thousand various compounds, mainly peptide hormones and kinins, have been synthesized and studied in the last decade. Modification of some amino acid radicals of peptides usually leads to a more or less marked decline of specific biological activity. On this basis, a conclusion is made as to the importance of a given amino acid radical or group to the biological effect. However, such a purely empirical approach to the study of the correlation between structure and biological activity offers little to comprehension of the fine mechanism of action of a peptide, since the functions performed by a given radical in the process of hormone-receptor interaction remain unknown. All this is indicative of a need to find new routes of investigation.

In the mid 1960's, research was begun in the Laboratory of Peptide Chemistry of the Institute of Organic Synthesis, Latvian Academy of Sciences, to find new methodological and experimental approaches to the study of the mechanism of action of low molecular peptide hormones and kinins. The authors selected two theses of systems analysis as their methodological approach: use of principles of information theory, cybernetics in studies of complex stochastic systems and the modeling method with extrapolation of results from one complex system to another. The latter thesis is consistent with the conception of biochemical universality, according to which the principles and patterns of peptide-protein and protein-protein interaction should be the same for all biochemical systems of the ligand-receptor, enzyme-substrate, antigen-antibody, etc., types. Use of the main theses of systems analysis, as well as taxonomy methods along with performance of a broad set of experimental studies in the field of bioorganic and physicoorganic chemistry, biochemistry, molecular pharmacology, conformation estimates and others, enabled the authors to disclose new general principles of formation of structures and function of peptide and protein bioregulators. The most important result of this approach was demonstration of peptide-protein ligands in structures differing considerably in origin and biological effects, which were similar in their chemical structure of segments, the so-called general [common] fragments. Analysis of structural and functional relations in series of various peptide hormones and kinins revealed that the biological effects of these compounds are not directly determined by their chemical structures as such, but by the set of properties of specific active segments of these structures; the sets of properties could be the same for compounds with different chemical structures. The discovery of common fragments enabled the authors to construct a model of structural and functional organization of some groups of peptide ligands on the level of their primary structure and, on this basis, to demonstrate experimentally that the molecules of many peptide ligands can reveal two active areas, one of which is specific and distinctive, causing selectivity of peptide-receptor interaction, while the other is common, universal and potentiates the action of the rest of the molecule by a factor averaging 10^{3-4}. The results of studying the biological activity of different fragments of peptide hormones warrant the belief that the common fragments are directly involved in activating cellular receptors in many cases. True, this is only one of the potential functions of common fragments. A total, semiempirical conformational estimate of spatial structures revealed that the most typical feature of spatial organization of low molecular peptides is their quasicyclic structure. Strong intramolecular interaction, including electrostatic, with the participation of functional groups of common fragment amino acids, is a factor that stabilizes the quasicycles. Thus, there was demonstration of a function of the common fragment that is very important to manifestation of specific biological effects--involvement in formation of spatial structures of molecules. Although the existence of quasicyclic structures in aqueous solutions is unlikely due to hydration of charged groups, the formation of quasicycles is quite probable in the case of dehydration of ligand molecules in the apolar biophase of cellular receptors. The validity of this hypothesis was checked by the authors by means of synthesis and investigation of the biological effects of model compounds--cyclic analogues of linear peptides, in which the hypothetical ion bond was replaced with a covalent one.

The second chapter of the monograph is concerned with analysis of the principles that determine ligand-receptor interaction in the case of formation of complexes of trypsin group enzymes with certain protease inhibitors. The submitted data indicate that, in this case, analogously to hormone-receptor interaction, the specificity of the processes is determined by small segments of the ligand, consisting of an average of 6 to 8 amino acid radicals, which have a relatively rigidly fixed spatial structure whose geometric profile corresponds to the active center--pocket of the enzyme molecule. It was found that the same patterns occur in the case of interaction of antigens with antibodies. Thus, we can refer to the existence of common, universal principles which determine peptide-protein and protein-protein interaction.

Demonstration of variants of common fragments containing cystine in the structures of a number of peptides and proteins is in favor of the assumption that common fragments participate in form production of molecules of peptide-protein ligands. Chapter 3 of the monograph submits the results of analysis of primary structures of sulfur-containing proteins. The equifunctional nature of salt and disulfide bridges in two families of homologous proteins (enzymes in the trypsin and lysozyme group) was proven.

Synthesis and investigation of the biological effects of different segments of molecules of peptide ligands with the typical structures of common fragments revealed that they had an unusually broad spectrum of biological effects. Interestingly enough, the structures of some unadulterated low molecular peptide bioregulators resemble the structure of the common fragments demonstrated by the authors. First of all, we must mention the antibiotics, leupeptin and antipain, as well as the unadulterated immunostimulator, tuftsin. The fourth chapter of the book deals with analysis of structural similarity of tuftsin [L-threonyl-L-lysine-L-proline-L-arginine] to certain other immunoglobulin fragments, as well as discussion of the biological effects and mechanisms of action of these compounds.

The last chapter deals with investigation of the correlation between structure and biological activity of two pituitary hormones--melanotropin [MSH] and adrenocorticotropic hormone. A comparison of the primary structures of these compounds to kinins--bradykinin and kinin from bee's venom--led to the conclusion that there is similarity of general structural organization of these compounds on the levels of both primary and higher structures, which was confirmed experimentally and, more recently, by synthesis of highly active cyclic analogues of adrenocorticotropic hormone.

In conclusion, it must be noted that the main general principles of structural and functional organization of some groups of peptide and protein bioregulators have been determined at the Institute of Organic Synthesis, Latvian Academy of Sciences, by a team of authors, as a result of many years of comprehensive studies, with the use of the main theses of systems analysis and a broad assortment of experimental methods. The obtained data make it possible to selectively design and synthesize new cyclic analogues of hormones and other peptide-protein bioregulators in laboratories, and, unlike their unadulterated prototypes, they are more selective and have action that is longer by several orders of magnitude in living organisms. For example, the cyclic analogues of tissular hormones, bradykinin and kallidin, are active for several hours in an organism, in contrast to native hormones that are dissociated within several dozen seconds. Cyclic peptides are quite promising for use as the basis of new drugs.

The monograph by G. I. Chipens et al., "Structure and Function of Low Molecular Peptides," opens up some new and quite promising directions of research in the area of chemistry and biology of peptide and protein bioregulators.

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CULTIVATION OF INSECTS AS NEW BRANCH OF ENTOMOLOGY--INDUSTRIAL ENTOMOLOGY

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[Article by N. A. Tamarina, Biology Faculty of Moscow State University]

[Text] The general principles and methods of cultivating insects are formulated as a new branch of applied entomology--technical entomology--whose methodology should be the systems approach and optimization theory, which are based on modern computer technology. One should view cultivation of insects as development of artificial populations with specified properties. The process of creating cultures is divided into three periods: 1) introduction of species into the laboratory; 2) development and standardization of cultures of different types; 3) creation of mass scale cultures with specified properties. The tasks and methods of each period are discussed. A new classification is offered for insect cultures.

Useful insects have been cultivated for a long time, but for a long time the range of organisms bred was limited. Apiculture and sericulture, which are aimed at very special objects,developed as independent industries, in spite of age-old traditions. There has been a drastic increase in the need for insect cultures in the last few decades, which is related to the initiation of work on biological methods of controlling harmful insects. Research on the effects of insecticides and acquisition of immunity to them by insects also drew attention to cultivation methods.

Methods for mass scale breeding of many insect species have been proposed (De Bakh, 1968; Smith, 1968), including those intended for use as a biological method of controlling crop pests in the USSR. However, unlike microbiology, where cultivation developed into a special branch--technical [industrial] microbiology--insect breeding has not yet been isolated as an independent discipline with its own methodology, methods and principles. Yet our research and analysis of the literature convince us that one can formulate the general principles and methods of a new branch, technical entomology, whose purpose is to reproduce insects. Shaping up insect cultivation as an independent branch of applied entomology should draw attention to theoretical aspects of research, development of which will aid in expediting unification and reducing the cost of production. Cultivation of insects should be viewed as development of artificial populations with specified properties, on the basis of ecological physiology and population ecology.

The process of creating cultures is divided into three stages: 1) introduction of species into the laboratory; 2) creation of cultures of different types conforming to the specifications of a concrete program and standardization thereof; 3) creation of mass scale cultures with specified properties. The tasks and methods of each stage are different.

Introduction of Species Into the Laboratory

The main task at the first stage of cultivation is to obtain a continuously reproducing culture of a given species in the laboratory.

By definition of WHO experts (WHO Scientific Group ..., 1964; "Standard Strains of Insects ..., 1966; Pal, 1967), laboratory cultures refer to a population of insects that have undergone at least one complete life cycle in the laboratory. Consequently, up to this time, we can merely refer to upkeep of field material in the laboratory.

By far not all species can be easily transferred to a laboratory. Laboratory upkeep and cultivation are made difficult because of poor mating, extension of oviposition time, low percentage of hatching and desynchronization thereof, prolong diapause, etc. The genetic heterogeneity of populations is the reason why they differ as promising material for cultivation. It is known that populations may differ in depth of diapause, behavior in copulation, behavior of females in oviposition, etc. For this reason, much attention should be given to the study of native populations and choice of base material for cultivation.

In some cases, a certain period of adaptation to laboratory living conditions is sufficient for the normal reproductive process to begin. Such adaptation is based on ecological flexibility and individual variability of specimens in natural populations.

When a species is introduced into culture one can use breeding methods, for example, to obtain lines from populations, only a few specimens of which mate in the laboratory, or to create diapauseless lines, most of whose specimens present monocyclic type of development in nature.

In many cases, special conditions have to be provided for continuous reproduction of cultures. A classical procedure is to control the photoperiodic reactions of insects (Danilevskiy, 1961; Vinogradova, 1969; Zaslavskiy, 1974, 1975). Regulation of seasonal development of polyvoltine species has been widely adopted in the practice of laboratory cultivation. In recent years, methods have been proposed for the control of some forms of imago diapause in monovoltine species (Zaslavskiy, 1970; Sem'yanov, 1974). Not infrequently, one has to create special conditions during the period of insect mating, for example, to set the circadian photorhythm. At the first stage of cultivation, natural feed is generally used, and the study of the natural diet of insects is one of the important elements of cultivation. In addition, artificial feeding, insemination, etc., methods can be used. Development of a method of artificial insemination of mosquitoes (McDaniel, Horsfall, 1957, and others) made it possible to cultivate many eurygamous species.

In-depth knowledge of the biology of a species, proficiency in experimental methods and updated equipment in the insectarium constitute the basis for solving the problem of introducing species into the laboratory, which consists of maintaining field material and creating laboratory cultures from it.

Typing and Standardization of Cultures

The second stage of work consists of creating different types of cultures and standardizing them. The type of culture is specified in accordance with the practical purpose and with consideration of biological capabilities of the species.

There are two conceivable means of creating cultures of different species. One is genetic, which implies regulation of the genetic composition of laboratory populations. The selection [breeding] method can be used to obtain cultures of insects with special properties, for example, with sterility of males, capacity for competing with other males, sensitivity or resistance to pathogenic microorganisms, temperature and insecticides. Of great interest are genetic methods of separating insects according to sex, which permit obtaining cultures consisting of males or females. Strains that are intended for release into the environment can be genetically marked to facilitate subsequent monitoring. It has been shown that optimum models of control of the breeding process can be developed (Rasch, 1973).

The other means of creating cultures of different types could be called ecological. It consists of obtaining phenotypical differences in laboratory cultures within the range of the physiological [vital] optimum.

The concept of vital optimum has been discussed considerably in the literature and continues to be discussed. Authors have proposed various criteria, from different vantage points, to define the optimum. Kozhanchikov (1948) believed that the main criteria of vital optimum are minimal energy expenditure for growth and development, low mortality and maximum fertility. While Goryshin (1966) generally accepted the validity of this opinion, he indicated that the energy criterion is not very convenient, due to difficulty of evaluation thereof, and he proposed that minimal mortality, minimal variability of all stages and parameters of development and maximum fertility of individuals be used as a practical criterion of the optimum. Goryshin believes that these parameters are the most generalized indicators of favorability of developmental conditions. In accepting these theses, we wish to stress that, from the standpoint of optimization of systems, the range of changes in exogenous factors, within which compensatory mechanisms function and maintain the population on the level of optimum intensity of vital functions, should be construed as the optimum range ["zone"]. Keeping a culture in the optimum zone assures stability of its existence (Pristavko, 1975; Tamarina, Maksimov, 1978, 1980; Tamarina et al., 1981a).

One should use the ideas and methods of systems analysis and theory of optimization of systems to find the optimum zone and create different types of cultures in its range (Nalimov, Chernova, 1965; Rozen, 1969; Patten, 1971; Gorskiy, Adler, 1974; Adler et al., 1976; Moiseyev et al., 1978). Since the works of Box and Wilson (1951) were published, theory of planning extreme experiments developed rapidly, but practical studies are lagging behind its advances, although the need to apply the theory to special models is obvious.

There are very broad possibilities in biology for optimizing systems by means of planning extreme experiments (Maksimov, Fedorov, 1969; Maksimov, 1975; Lisenkov, 1979). This fully applies to problems of cultivating insects (Pristavko, 1975; Tamarina, Maksimov, 1978, 1980; Starets, Mencher, 1980). Most problems of cultivating insects amount to optimizing the process by means of planning experiments to maximize or minimize functions. Insect cultures should be viewed as systems consisting of interrelated and interacting elements. A change in each element affects other elements and function of the system as a whole.

Expressly the systems approach and optimization theory are called upon to become the methodological foundation of industrial entomology. Use of system optimization methods permits simultaneous investigation of a large number of factors, quantitative evaluation of the effect of each factor and interaction between them, obtaining a mathematical model of the process, on the basis of which a further search is pursued for the optimum zone or production of culture (Tamarina, Maksimov, 1978, 1980; Tamarina et al., 1981a).

The problem of standardizing cultures was discussed at the symposium in Gainesville ("Symposium on Methods for Cultivating Arthropoda ...," 1964). As shown by discussion, there are two possible means of standardizing cultures: obtaining genetically pure lines and creating cultures with stable biological properties (biological standards).

The WHO research group on the genetics of vectors and insecticide resistance worked out recommendations for developing standard strains of insects important to medicine ("WHO Scientific Group ...," 1964; "Standard Strains of Insects ...," 1966; Pal, 1967). It was proposed that the following classification of laboratory populations be adopted: A. Field material and laboratory colonies: 1. Field material. 2. Laboratory colonies. B. Standard strains: 1. Inbred lines. 2. F_1 hybrids. 3. Standard strains. 4. Strains with genetic markers.

Standard strains are developed by genetic methods. The term, "inbred line," is used for strains that have been created and kept at a homozygosity level of at least 95%. Inbreeding has negative properties, and it is not desirable to use inbred lines in experiments. Viability and fertility are markedly reduced in inbred lines. Occasionally they present wide variability of reactions to experimental factors. In order to obtain large quantities of material for experiments one must allow for extensive cross-breeding of inbred offspring. The first hybrid population (F_1) from crosses between two inbred lines is recommended for experimental work. F_1 specimens are usually better adapted to the environment than either parental lines, and for this reason they are more viable. Heterosis provides for homogeneity of reactions to experimental factors, synchronous growth and development. First general hybrid specimens are genetically homogeneous, since all individuals have the same haploid set of chromosomes from each inbred parent. However, F_1 hybrids cannot be used for subsequent breeding, since heterosis is impaired in the second generation (F_2). The second generation presents considerable variability, and for this reason is of no value. The cultures become ordinary polymorphous ones after 5-6 generations.

Standard strains are created for special purposes and are homozygous for only one character that is of interest to them. The rest of the genetic pool is heterozygous.

Creation of strains with genetic markers implies introduction of the appropriate mutants. It is considered best to introduce one or several markers in the strain characterized by maximum isogenicity.

Use of standard strains is stricly specific: each strain must be developed for a specific purpose, based on the concrete objectives of the research. Breeding genetic lines is a long, laborious, expensive and specialized process, which can only be handled by specialists in this type of work.

The main advantage of laboratory cultures, as compared to inbred lines, is the simplicity of breeding, which makes it possible to obtain large amounts of material. However, the fear has been expressed that too stereotypic cultivation conditions present the risk of obtaining cultures that are not sufficiently adapted to existence in the field. One of the methods of maintaining the natural traits of insects is to introduce insects from natural populations into the laboratory culture. Special importance is attributed here to preservation and monitoring behavioral reactions. At the same time, the old culture acquires some genetic stability, as manifested by stability of biological parameters and homogeneity of reactions to experimental factors, and the old cultures are more convenient for experimental work.

Some of the flaws of laboratory cultures are aggravated by the fact that, unlike genetic cultivation methods, little attention is given to finding general principles of work and characterization of cultures. As a result, the properties of laboratory cultures are variegated. The participants at the symposium in Gainesville unanimously agreed that it is necessary to standardize the biological parameters of cultures, such as duration of development, weight of specimens, life span, fertility, etc. It was recommended that studies be pursued of the biological norms of the created cultures in order to determine which parameters should be standardized. Various cultivation methods should be altered and refined until the established biological parameters are obtained. Tamaki et al. (1972) proposed the use of life cycle tables to evaluate different cultivation methods.

However, there are still no conventional methods of standardizing cultures. For this reason, we call attention once more to the need of using mathematical methods of optimizing systems in creating cultures. These methods make it possible not only to find the optimum zone, but quantitatively describe the system under study, including determination of level of variability of indicators of culture traits, selection of the most important ones, determination of sample size for evaluation of parameters with specified accuracy and establish the standard, i.e., provide certificates [or register] for cultures. Within the range of the biological optimum of the system, improvement of some properties may be associated with some worsening of others by virtue of compensatory reactions. Consequently, evaluation of the biological optimum amounts to a search for a compromise combination of several parameters. It is expedient to use the function of desirability (usefulness) as a general criterion of culture quality to solve such a problem (Adler et al., 1976; Mencher, Mishina, 1978; Starets, Mencher, 1980; Tamarina et al., 1981). We have refined the principle of standardization of insect cultures with the use of desirability function on the example of a mosquito culture. It is unified [standardized], and for this reason can be used to standardize cultures of any insect species.

Creation and Production of Mass Scale Cultures

The third stage involves creation of mass scale cultures with specified properties. The main task is to refine the process of obtaining insects in large amounts, whose properties were specified in the course of typing and standardizing. A standard culture does not necessarily have to be converted into a voluminous one, but typing and standardization precede development of a voluminous culture. The question arises as to when does a culture become voluminous. We should concur with Odi (1964) that this happens at the time when the very principles of cultivation are changed, when new programs are needed for each stage of work that ultimately lead to an increase in culture. Indeed, it would be inconceivable to create voluminous cultures without consideration of such factors as number of specimens in culture plants, density thereof, proportion of sexes, fertility and mortality. Here, the importance of population patterns, including mechanisms of self-regulation of population size, becomes obvious.

When developing artificial populations in the form of monocultures, intraspecies regulatory mechanisms acquire the chief importance with regard to restricting the number of specimens. They are involved as factors that limit the number [of specimens] only when the population density is high. This is the biological prerequisite for obtaining cultures with high enough density of specimens, in other words, for creating an effective mass-cultivation process.

One can create continuous voluminous cultures by using the mechanisms of self-regulation of population size. It is simpler to do this when the life cycle of organisms is minimally differentiated. Continuous flow cultures of microorganisms based on the laws of growth in population size are well-known.

One can create continuous cultures of organisms with complex life cycles, which include insects. In some cases, continuous insect cultures may be promising, since it is possible to simplify the technological process. This applies to insects whose entire life cycle proceeds in the same habitat. When various developmental stages correspond to different environments, the process of continuous cultivation becomes much more complicated. In such cases, periodic cultivation is more expedient, where the process stops with completion of the cycle.

Mass scale cultivation differs from laboratory cultivation in technological criteria as well. First of all, there is the criterion of production cost (Gast, 1968). Pristavko (1975) formulates the task of mass production of insects, with consideration of production cost, as achievement of maximum productivity with minimal expenditures and maximum quality of final product. The author stresses that the change to mass cultivation requires development of new technology, with constant evaluation of the influence of technology on product quality.

One can consider a mass culture to have been created if it has become controllable, i.e., the cultivation process has been refined to such an extent that the prescribed level of reproducibility of results is achieved in accordance with a specific rule [regulation]. Nonspecialized personnel can service production of such a culture. The task for qualified specialists is to monitor product quality and control the production process.

It is expedient to use the ideas and methods of evolutionary planning (Tamarina et al., 1981a) to control the production process. One of the main properties of biological systems is drift in time. Traditional methods of cultivating organisms in accordance with stable regulations cannot theoretically assure reliable reproducibility of culture traits due to the constant time drift of the system (seasonal, genetic, etc.). Moreover, the process of introducing developed methods into other laboratories encounters uncontrollable factors. Even greater difficulties arise when the methods are transmitted to industry. Stable production regulations could disrupt the production process, since there are no provisions for remedying a crisis situation.

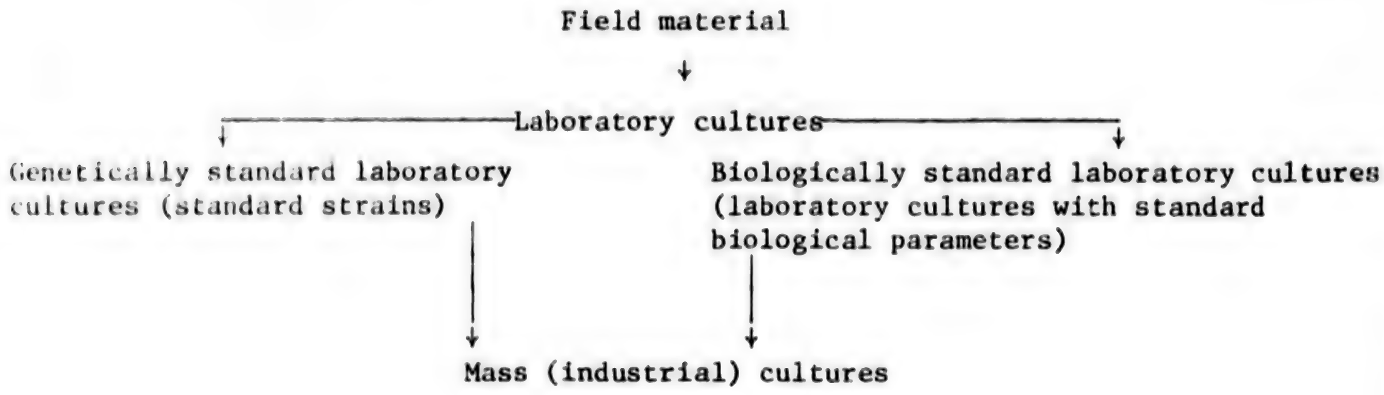
Inclusion of optimization in the production process is the basic novelty in the method of cultivation with the use of evolutionary planning. In other words, there is continuous optimization during the production process, taking into consideration its distinctions and fluctuations. A statistically validated plan for the initial cultivation cycle and strategy for subsequent management of the production process are refined in creating the culture. The method is programmed for shifting the optimum and makes it possible to control the production process in the event of instability, regardless of its cause, in order to augment the yield of standard product. Plans for a complete factored experiment can be used, as well as D optimum plans, plans with the simplex [method], etc. The systems approach and optimization methods make it possible to standardize and algorithmize the process of creating and producing cultures. In any case, the algorithm has four stages: 1) formulation of task and choice of independent variables (controlling factors--X_j--and indicators of quality of the culture--Y_i); 2) search for optimum zone; 3) standardization of culture; 4) production of culture using the scheme of evolutionary planning. High-speed methods of creating and producing controlled optimized standard cultures of insects referable to different groups can be refined on the basis of the algorithm.

In the above plan, insect cultivation meets all production requirements. Any industry is characterized by three indicators: assortment of products (in our case, assortment is represented by cultures of different types), their quality (standardness) and quantity (voluminousness). The volume and rhythm of production can be simulated on a computer for the prescribed level of production on the basis of laws of population growth (Beglyarov, Dunskiy, 1968; Aleksandrova et al., 1978). Modeling the dynamics of population size is an intensively developing area of research. Many models can be used to control artificial populations or are developed specially for them (Monro, 1965; Lefkovitch, 1967; Svirezhev, Yelizarov, 1972; Anderson, 1975; Svirezhev, 1975, and others).

We are not dealing here with some important but special aspects of insect cultivation, such as sanitary and epizootiological monitoring, technology of mass breeding, including choice and optimization of nutrient media, mechanization and automation of processes developed in some cases to the point of continuous-flow lines and programmed automatic systems, and a number of others, where the specifics of the object of cultivation are more involved. But even in these cases, there are general patterns of running the cultivation process.

It is expedient to return to the question of classifying insect cultures. We believe that the terminology and classification of insect cultures can be submitted as follows at the current stage [see chart on the following page].

The term, "laboratory cultures," should have been opposed to "industrial cultures." However, the term, "mass [voluminous] cultures" has gained a rather firm foothold in the literature and emphasizes the main difference between industrial and laboratory cultures, their mass scale. Probably, both terms could exist as synonyms.


Field material
Laboratory cultures
Genetically standard laboratory cultures (standard strains)
Biologically standard laboratory cultures (laboratory cultures with standard biological parameters)
Mass (industrial) cultures

Thus, insect cultivation has already developed into a rather vast branch of entomology. Apparently, this branch has its own tasks, methodology and principles. The formation of industrial [technical] entomology as a special sector with scientific research centers and publications should concentrate ideas and stimulate their development, provide for growth of personnel, enlarge and intensify production on a higher theoretical level. One should refer also to industrial entomology the problem of waste utilization by means of insects, including life support systems in space, which is similar to cultivation of insects in its methodological approaches.

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10,657
CSO: 1840/107

UDC: 575:576.851.5/48

CLONING AND EXPRESSION OF PROMOTOR-CONTAINING FRAGMENTS OF DNA OF BACILLUS THURINGIENSIS IN ESCHERICHIA COLI CELLS

Moscow GENETIKA in Russian Vol 17, No 12, Dec 81
(manuscript received 25 Aug 81) pp 2100-2104

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[Abstract] Promoter sequencies of DNA of Gram-positive sporulating bacteria (Bac. thuringiensis subsp. galleria 69-6) were cloned on plasmid pGA24. pGA24 and Bac. thuringiensis DNA were isolated, HindIII restrictase was used to separate the DNA samples in a 1:3 ratio (vector:donor DNA), using phage T4 polynucleotideligase to join them. Ligated DNA was transformed in E. coli strain HB101$r_k^-m_k^-$ and cultured in dishes with L-agar and tetracycline or ampicillin after expression. Ap^r colonies were tested for acquisition of resistance to tetracycline. Electrophoregrams and autoradiograms of recombinant plasmids treated with HindIII restrictase are illustrated, as well as polypeptide synthesis on a plasmid DNA template. The characteristics of recombinant plasmids with Bac. thuringiensis promotors are tabulated, listing resistance to antibiotics, homology with B. thuringiensis DNA, size of cloned fragments, instability and resistance to tetracycline. Promotor activity was demonstrated in the cloned HindIII DNA fragments, indicating that there are many B. thuringiensis genes capable of expression in E. coli cells. These results make it possible to go on with studies of biological barriers to expression of enterobacterial genes in cells of Gram-positive bacteria. Figures 2; references 15: 1 Russian, 14 Western.
[95-10,657]

UDC: 631.523:591.81

EXPERIMENTAL GENE TRANSFER IN MAMMAL SOMATIC CELLS

Moscow USPEKHI SOVREMENNOY BIOLOGII in Russian Vol 92, No 5, Sep-Oct 81
pp 163-179

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[Abstract] This review discusses primarily the results of experiments on eucaryotic gene transfer in the cells of eucaryotes using deproteinized DNA and metaphase chromosomes. The primary systems used for testing transform cells are mentioned. Experiments on gene transfer with metaphase chromosomes and deproteinized DNA preparations are reviewed. The results obtained in experiments on mammal cell transformation with linear foreign DNA have shown that gene transfer, integration into foreign DNA and normal expression are quite possible, utilizing the mechanism and enzyme systems existing in the recipient cells. There is now no doubt that somatic mammal cells are capable of accepting foreign DNA both as chromosomes and as deproteinized molecules. The effectiveness of gene transfer is, however, usually very low. The reason for this is the insufficient development of experimental techniques. In spite of these difficulties, studies performed in this area are of great interest for a wide variety of purposes. They indicate the possibility of common mechanisms for all types of DNA transfer in the genome. Figure 4; references 58: 2 Russian, 56 Western.
[116-6508]

UDC: 547.963.32

CLONING AND IDENTIFICATION OF HUMAN LEUKOCYTIC INTERFERON GENE USING SYNTHETIC OLIGONUCLEOTIDES AS PRIMER AND PROBE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 3, Jan 82
(manuscript received 16 Dec 81) pp 725-728

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[Abstract] One of the genes of human interferon was cloned in the HindIII site of PBR322 DNA, and interferon-enriched cDNA was synthesized with synthetic

oligonucleotide priming for reverse transcription; another synthetic oligonucleotide was used as a probe for selection of recombinant clones. First mRNA was isolated from human leukocytes induced by Newcastle virus, and it was used as the template for reverse transcription. Nucleotide sequence of the cloned interferon gene and its amino acid sequence were mapped. Obtained cDNA was connected with HindIII linkers and inserted in pBR322 plasmid. Postligation mixture was used to transform E. coli K802, and 30,000 Ap^rTc^s transformants were obtained. These colonies were identified by hybridization on filters with ^{32}P-labeled primer, and 40 presented a positive response, then used for further analysis, on the basis of which 6 clones were selected having plasmids with two PvuII sites, which is a feature of interferon genes. Figures 2; references: 12 Western.
[98-10,657]

UDC: 575:576.851.155

GENETICS AND GENETIC ENGINEERING OF RHIZOBIA

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA BIOLOGICHESKAYA in Russian No 6, Nov-Dec 81 (manuscript received 14 Apr 81) pp 805-822

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[Abstract] This is a survey of research done on nodule-producing bacteria, which are important among nitrogen-fixing microorganisms to leguminous agricultural crops as a source of bound nitrogen. Information is given about rhizobial plasmids (demonstration, features, biological function), genetic research (mutagenesis, transfer of genetic material, genetic maps, interspecific crossing and R', special rhizobium mutants) and genetic engineering trends. Research in these directions is being pursued in all developed countries, and comprehensive information about the biology of rhizobia has already been published. They are Gram-negative microorganisms of two types: fast and slow growing (3-4 h and 6-8 h generation time), and each species has one or more host legume with which effective symbiosis occurs (host specificity). Their most important characters are capacity to form nodules and symbiotic nitrogen fixation, which are also related to the host plant genotype. Mutant strains of R. japonicum have already been obtained which have a greater capacity for symbiotic nitrogen fixation, as tested in hothouse experiments on soybeans. References 96: 4 Russian, 92 Western.
[102A-10,657]

UDC: 576.8

MICROBIOLOGICAL DEGRADATION OF OIL POLLUTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA BIOLOGICHESKAYA in Russian
No 6, Nov-Dec 81 (manuscript received 23 Oct 80) pp 835-844

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imeni M. V. Lomonosov

[Abstract] A survey is made of the research done on microbiological degradation of petroleum hydrocarbons, as well as quantity of active hydrocarbon-oxidizing bacteria, effects of environmental factors, including in-depth studies of microorganisms themselves--structure of cells, biochemical mechanism of hydrocarbon oxidation, metabolic products, cultivation of hydrocarbon-oxidizing bacteria in media differing in salinity, hydrocarbon utilization by mycobacteria and arthrobacteria, involvement of Pseudomonas in oxidation of petroleum hydrocarbons. It was found that active hydrocarbon-oxidizing microorganisms utilize hydrocarbons by means of passive diffusion, so that levels of 0.1% or more are needed for growth of bacteria, whereas with lower levels microorganisms must meet the following requirements: mobility and positive chemotaxis for hydrocarbons; effect co-metabolism; have active transport for hydrocarbons and ability to absorb them from a dissolved state and, apparently, some quantity of bacteria of the genus Pseudomonas. As microbiological oxidation proceeds, with growth and reproduction of mycobacteria and arthrobacteria, hydrocarbon concentration diminishes to a nontoxic level for other microorganisms, and the medium becomes enriched with vitamins, lipids and other organic compounds derived from the initial oxidizers. New methods must be sought to find microorganisms that break down hydrocarbons present in levels insufficient for mycobacteria and arthrobacteria to utilize as substrate. References 53: 35 Russian, 18 Western.
[102A-10,657]

ECOLOGY

UDC: 577.48:599.323.4

EFFECT OF NATIVE BIOGENOUS COMPOUNDS ON BEHAVIOR AND REPRODUCTIVE FUNCTION OF MALE HOUSE MOUSE, MUS MUSCULUS L.

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 3, Jan 82 (manuscript received 29 Jul 81) pp 746-748

NOVIKOV, S. N., TSAPYGINA, R. I., DAYEV, Ye. V. and TOGO, Ye. F., Institute of Physiology imeni I. P. Pavlov, USSR Academy of Sciences, Leningrad; and Leningrad State University imeni A. A. Zhdanov

[Abstract] In view of the belief that chemical communication is probably the main form of intrapopulation regulation of structure and number of house mice, studies were pursued to determine the effects of pheromones as selective and inexpensive, as well as nonpolluting, agents to control natural processes. Experiments were conducted on F1(CBA C57Bl/6) [$CBAB6F_1$] male hybrid mice, who were switched (at the age of 21 days) for 2 h/day (for 10 days) to cages containing the litter of fertile males of other strains kept there for 2-3 weeks previously. Animal behavior was assessed by the "open field" method. Effects of excreta of unrelated males on reproductive function were studied also. Excretory products increased the incidence of meiotic disturbances, the effect being the most marked 8 h after exposure. Interstrain differences were demonstrated in effects of excreta on the young hybrids, with regard to both behavior of recipients, meiosis and spermatogenesis. The next subject of investigation is to determine the extent to which pheromones inhibit motor activity and spermatogenesis in animals of different genotypes. The ultimate goal is to identify pheromones that have the strongest influence on reproduction and ecology of the house mouse. Figures 1; references 15: 3 Russian, 12 Western.
[98-10,657]

ENVIRONMENT

UDC: 599.323.4

ORIENTING AND EXPLORATORY BEHAVIOR OF GRAY RAT IN 'OPEN FIELD' (ZOOPSYCHOLOGICAL ANALYSIS)

Moscow BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY: OTDEL BIOLOGICHESKIY in Russian Vol 86, No 6, Nov-Dec 81 (manuscript received 8 Jul 80) pp 22-29

[Article by N. N. Meshkova]

[Text] The behavior of animals, in particular small rodents, is different in familiar and unfamiliar territories. In the former case, they move about confidently and purposefully, occasionally stopping for orientation and, in the presence of danger, dash for the nearest shelter. In the latter case, they move busily in different directions, often stop, look around, sniff and stop dead in their tracks or start to dash about in the presence of danger (Soldatova, 1972; Nikitina et al., 1977). Studies have only begun in the area of determining the mechanisms (physiological and psychological) of the process, during which new territories become familiar to an animal. Experiments conducted on small rodents (Kroukroft, 1970; Smirin, 1975) revealed that immediately after being let out in a new room, intensive orienting and exploratory behavior suppresses temporarily all other forms of animal activity. It gradually diminishes and the animals start to make use of the territory in accordance with its features: they occupy shelters, start to feed and their movement becomes more orderly.

Our objective here was to make a comprehensive study of orienting and exploratory behavior of gray rats in new surroundings and to analyze the obtained data from the standpoint of conceptions of the link between their behavior and psyche (Leont'yev, 1952, 1959, 1977; Gal'perin, 1966, 1976; Zaporozhets, 1958; 1960; Fabri, 1976).

Methods and Experimental Animals

This study was pursued with gray rats (Rattus norvegicus) from a population raised by K. L. Lyapunova in the vivarium of the Institute of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences. While they retained the main behavioral traits of wild rats, they were notable for diminished aggressiveness against man. All of the experimental rats were born and raised in our laboratory. They were kept in groups of 3-4 of the same sex in cages 30×30×25 cm in size. Experiments were conducted on animals 6-7 months of age.

The premises, with which the rats were to become acquainted, constituted of an "open field," 140×140×70 cm in size, made of yellow opaque plexiglas. During the experiments, the "field" was illuminated by one 15 W light bulb 1 m above the center. Illumination of the middle of the "field" constituted 30 lux and at its edges 24-26 lux. The rats (group of 3-4) were placed in the "field" in their own cage with the door open. It was deodorized after each experiment.

Two series of experiments were conducted. In the first (5 experiments with each group, one a day) our objective was to observe the dynamics of locomotor assimilation of the "field" and inspection of objects in it (walls and floor, outside of their own cage), as well as to describe the elements of their orienting and exploratory behavior. We placed the animals in the "field" for only 15 min/day for more distinct manifestation of the different stages and distinctions of familiarization with the new territory. In this series, we used 11 groups of animals. We observed the behavior of 16 rats with sketching in of their individual trajectories.

The existing methods of objective recording of motor activity did not conform entirely to the objectives of our study. For this reason, using the most suitable method as the basis, which had been used in experiments to develop conditioned situational reflexes (Kupalov et al., 1964), we modified and expanded it to apply for the study of orienting and exploratory behavior. We recorded the animals' behavior in the following manner: We reproduced the "open field" on a 1:17.5 scale on a sheet of mm graph paper 40×30 cm in size. Fifteen such reproductions (plans) fit on one such sheet, one for each minute of the experiment. We plotted the route of rat movements on the plan and marked with conventional designations the place, duration and nature of inspection of objects, nature of locomotion, as well as different elements of feeding, comfort and aggressive behavior.

In the second series, we conducted 10 experiments with each rat group. This series had to be performed because of the need to observe how the animals behaved during spatial orienting positions. We used three groups (2 rats in each) in this series. We reduced the number of animals to two because of the need to limit their orientation toward one another as much as possible. We observed individually the behavior of three animals, drawing in their routes. In this series, we marked on the plans, in addition to the parameters listed above, the duration of maintaining spatial orientation stances ("stands"), position and orientation of the animal's face. In all, 85 experiments were conducted.

The route traveled by the rats was measured with a curvometer; we measured the duration and counted the number of different behavioral acts, and compiled the qualitative characteristics of changes in orienting and exploratory activity of the animals as they became familiar with the "field."

Results

Elements of Orienting and Exploratory Activity of Gray Rats in 'Open Field'

We singled out the following behavioral components: spatial orienting stances, movement, inspection of objects and behavioral acts not outwardly related to inspection of the terrain. Each of them has typical features and can be readily distinguished from the overall continuum of behavior.

Spatial orientation stances: They are the start of orienting and exploratory behavior. During such a stance, the animal is either motionless or else, remaining in place, turns its head, wiggles its ears and nose; its body is tense and attention is directed toward the space before it. We observed several typical stances.

1. The rat rests on all four extremities, the head is motionless, the snout directed forward and posterior legs are slightly flexed. This is the most frequently recurring position.

2. The rat rests on the hind legs, its body is almost erect, the head motionless, the snout directed forward and slightly upward. This position was observed less often than the first one, but more than the others.

3. Same pose as 2, but face directed up.

4. Same as stance 2, but the rat slowly turns its head to the right and left (scans the surrounding area horizontally).

5. Same as stance 2, but the rat slowly raises and drops its head (scans the surrounding area vertically). In rare cases, scanning movements were observed in stance 1 also.

It should be noted that scanning movements while in spatial orientation stances were observed primarily in cases where the animals were in new parts of the "field" for the first time. The orienting stances lasted from 1-2 s to 1 min or longer. Prolonged orientation was referable mainly to the early stages of becoming acquainted with the "field" and short to the final stage.

Movement: We observed a slow, "creeping" pace (when they were almost in contact with the floor), usual (normal) pace, rapid pace changing to a run and ricocheting jumps. Most often, the animals moved along the walls of the "field" about 10 cm from them. Only 10-20% of the total route they traveled was in the middle of the field.

Inspection of objects: We observed sniffing, feeling with vibrissae, nipping, gnawing at the floor and walls of the "field," outside of their cage and scratching the floor. The rats paid attention more often and for longer times to horizontal and vertical joints of walls and floor, angles between the cage and "field."

Behavioral acts not outwardly related to inspection of territory: They included washing, digging and smelling the litter and feed in the cage, as well as drinking, eating, crawling in and gnawing the cage, attacking the another, fighting and washing one another. Although these actions are included in the usual behavioral repertory of rats in different functional spheres, we deemed it necessary to combine them here on the basis of several common features. We refer to the special, "vigorous" nature of their performance, sudden start and discontinuation of these elements unrelated to the preceding element, frequent alternation, as well as inconsistency of these actions to the animal's situation. For example, upon returning into the cage after being in the "field," a rat would immediately attack another one (not a single conflict was observed among the animals in other than experimental conditions), after a brief fight it would start to wash itself, then climb on the perforated cage walls, dig in the litter; the other rat would sit in a corner of the cage, after several attempts to go out in the "field" (afraid of new terrain), and begin to wash feverishly for several minutes, then gnaw at the screen.

There were individual differences in manifestation of separate elements of behavior. For example, some rats did not change to running and jumping at the last stage of becoming familiar with the "field," and moved only by walking. Some animals presented frequent and prolonged easy ["comfortable"] behavior, whereas in others it was observed in isolated instances.

Dynamics of Orienting and Exploratory Activity

With increase in time the animals spent in the "open field," there were substantial changes in the behavioral components: change in behavior pattern, frequency and duration of different acts and their spatial localization. On the basis of these changes, we made a distinction between several stages of familiarization with new surroundings.

At the first stage there was initial familiarization of the rats with the new area, while still in the cage. Here we observed prolonged and frequent spatial orientation stances, first from the far end of the cage, then its threshold, as well as inspection of objects: at first the animals merely sniffed at the floor and walls of the "field," then they suspended themselves from the threshold and palpated the smooth plexiglas with their vibrissae. After this, they carefully stepped on it with the forelegs (one of the rats, scraped the floor several times before resting on it) and continued to feel it with their vibrissae. Then the most active animals went out of the cage, but most of them backed into it and began to vigorously wash, attack one another, etc.

After the very first exit into the "field," there was considerable reduction of time the animals remained in the cage. For example, in the first experiment, the delay (before the first exit) constituted a mean of 2.76 min, in the second 0.97 and in the fifth 0.33 min (first series). This was related to reduction in frequency and overall duration of orienting stances, as well as decrease and then discontinuation of inspection of the "field" from the doorway of the cage.

At the second stage, the rats familiarized themselves with the part of the "field" directly adjacent ot the cage (Figure 1a). After stepping on the smooth floor of the "field" for the first time, they moved at a slow pace, some of them virtually "crawled" close to the floor, stopping often and assuming an orienting stance in the direction of the "field" (Figure 2a). As they moved, they sniffed and touched the floor before them at virtually each step, nipped at the walls of the "field" and outer parts of the cage. They often returned into the cage, dug in the litter and attacked one another. At this stage, the rats eliminated large amounts of urine on the floor of the "field."

At the third stage, they familiarized themselves with the space along the walls adjacent to the cage and, in part, the central part of the "field (Figure 1b). The rats began to move about much faster in the immediate vicinity of the cage. In new areas, movement was slower but upon returning to the cage they sometimes walked rapidly and even ran. Prolonged (up to 10 s or more) orienting stances associated with locomotor assimilation of the terrain were observed mainly in areas where the rats had come for the first time (Figure 2b). Although orientation from the cage and near it persisted, it became considerably lower in frequency and different stances lasted 1-2 s. Concurrently with locomotor inspection of the territory, its elements in new sections were examined. As before, there were fights between animals, washing and other actions, but they were observed not only in the cage, but in the "field."

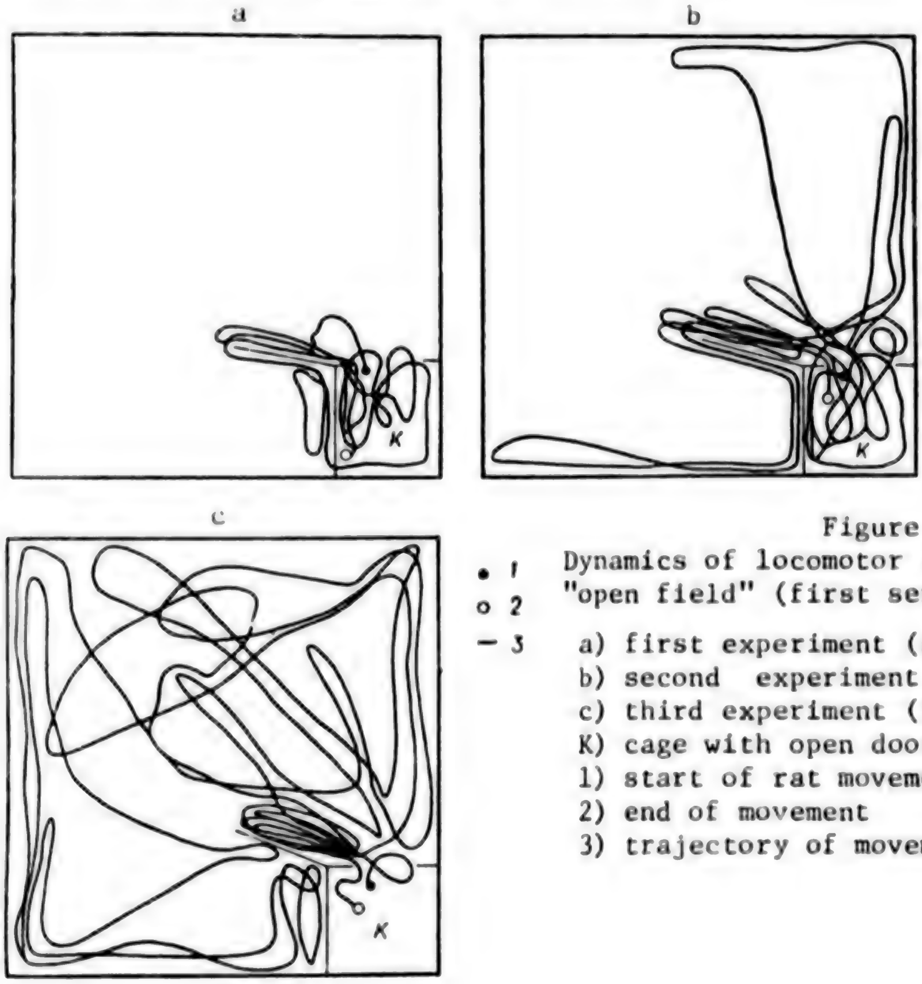

Figure 1.
Dynamics of locomotor inspection of "open field" (first series, female No 3)

a) first experiment (second stage)
b) second experiment (third stage)
c) third experiment (fourth stage)
K) cage with open door
1) start of rat movement
2) end of movement
3) trajectory of movement

At the fourth stage they became familiar with the area along the other two walls and central part (Figure 1c). Slow walking was observed only in areas that the rats entered for the first time; however, in some cases, returning to the cage they ran through unfamiliar parts of the center, and such runs were preceded by prolonged stances, during which the animals directed themselves toward their cage. As in the preceding stage, stances were observed in the sections of the "field" that were being explored for the first time (Figure 2c). There was appreciable decrease in average duration and frequency of stances. While there was 2 to 18 s of orientation in stances at the second stage per meter traveled, at the fourth stage they lasted several tenths of a second (second series). They still inspected objects--walls, floor, outside of the cage--but now the rats tried to gnaw and dig more than smell and feel them with their vibrissae.

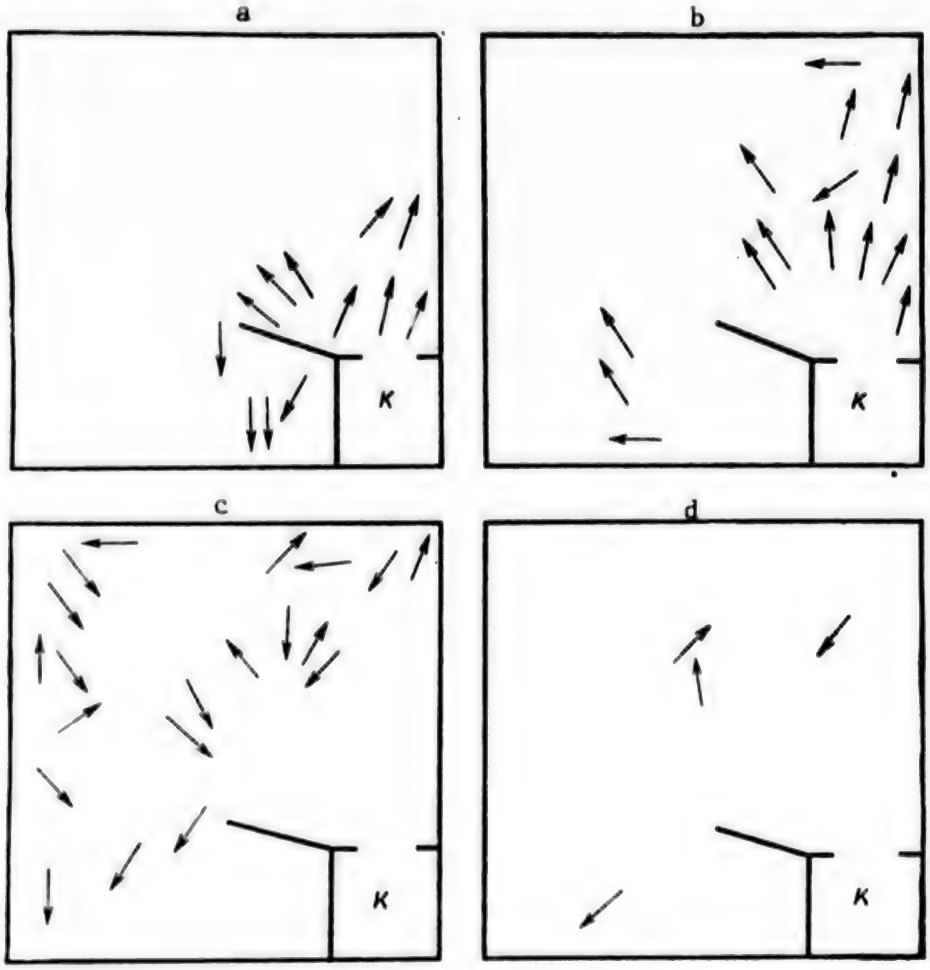

Figure 2. Dynamics of spatial orientation stances in exploring the "open field" (second series, male No 3)

a) fourth experiment (second stage)
b) fifth experiment (third stage
c) eighthexperiment (fourth stage)
d) tenth experiment (end of fourth stage

K) same as in Figure 1

The arrows show the direction of the animal's snout

By the end of the fourth stage, the animals became totally familiar with the "open field": they exited from the cage rapidly, while some literally jumped out into the "field" as soon as the door was opened; they moved freely and rapidly in all directions; there was considerable decrease in number and duration of spatial orientation stances (Figure 2d); if alarmed by noise (at the end of the experiment) the rats dashed back into the cage from all parts of the "open field."

Although the above-described order of becoming familiar with the "field" was inherent in all rats, there were considerable individual differences in speed of familiarization. The most active specimens became completely acclimated to the new terrain by the end of the second experiment, most did so in the fourth-fifth, whereas the most passive ones were unable to adjust to the "field" even by the end of the fifth experiment.

Discussion

Let us consider the role of the above-mentioned behavioral components in the course of adjusting to a new terrain and, concurrently, in the process of formation of a mental image of this terrain in the animals. Whenever the rats were faced with a new area we observed prolonged, virtually continuous orienting stances. During such stances, there is primary perception of the new surroundings and primary fixation thereof in memory. Subsequently, as they became familiar with the premises, when conditioned orienting associations are formed, the stances became few in number and brief, and their function changed--now it was recognition of a given part of the "field."

Along with the knowledge ["experience"] gained during the orienting stances, as well as when moving in the new surroundings, the experience gained from inspecting objects (walls and floor of the "field," cage) by means of vibrissae, the maxillary system, extremities, i.e., by means of manipulation, occupies a most important place in orienting and exploratory behavior (Fabri, 1958, 1963, 1976; Fabri, Meshkova, 1972; Deryagina, 1980, and others).

In spite of the sparsity of object content of the "field," as we saw, the rats inspected rather intensively the walls, floor and the outside of their cage. Since the experimental conditions required that there be no zones in the "field" that could subsequently acquire direct biological meaning for the animals (no feeding places, shelter, etc.), the existing objects apparently served only as reference points for movement. As indicated by observations in the field, the latter are a mandatory prerequisite for an animal's orderly behavior in a territory he occupies (Matyushkin, 1977).

In the course of adjusting to a new terrain, locomotion is the connecting link between behavioral components. A satisfactory image of the terrain is formed by virtue of numerous combinations of locomotor acts with perception of the "open field" and inspection of objects.

The elements of behavior that had no direct relation to inspection of the terrain can be interpreted as a manifestation of shifted activity. The latter is often observed in animals in conflict situations (Armstrong, 1950; Tinbergen, 1952; Barnett, 1958). Apparently, the new surroundings were a stressogenic factor for the rats, and the situation was one of conflict. Under such conditions, the increase in motor activity in the form of actions contained in the usual behavioral repertory performs an "antistress" function, blocking development of pathological changes in the body that occur if the animals remain motionless in conflict situations (Wickler, Seibt, 1975; Arshavskiy, Rotenberg, 1978). The fact that this behavioral component persisted in all tested rats throughout the time spent in the "field," leads us to assume that it is a mandatory element of their orienting and exploratory activity.

We indicated above that rats become familiar with a new terrain in a strictly specific order. Apparently, the experience gained by animals at the preceding stage is a necessary condition for each new stage of orienting and exploratory activity. Formation of a mental image of a given terrain starts with the first moment spent by rats in the "field," and upon completion of the fourth stage it becomes the most complete. Concurrently, the behavior of the rats becomes completely consistent with the concrete conditions of the new surroundings. In a natural situation, or one close to it, this would have an adaptive effect, as confirmed by the experiments of Yu. M. Smirin (1975): common field mice and common redbacked voles in a small area, but one with which they had become very familiar, succeeded in avoiding attacks by an owl that lived there.

We compared data on the distinctions of rats' familiarization with the "open field" to the results obtained in nature by A. N. Soldatova (1955), who observed how young small susliks familiarized themselves with the individual area of a female after coming out of their burrow for the first time. Like the rats in our experiment, the susliks had no prior experience in exploring a new territory. They also oriented themselves for long periods of time near the burrow, often returned to it, first examining the area closest to the burrow then remote parts; they moved rapidly over explored territory, only occasionally standing erect. The demonstrated similarities warrant the assumption that, in this case, there was the same process of gradual formation of a mental image of the surrounding area.

Conclusions

Orienting and exploratory behavior of gray rats in an "open field" contains the following behavioral elements: 1) spatial orienting stances; 2) movement; 3) inspection of objects; 4) actions referable to the category of shifted activity. Each of these elements can be readily distinguished in the continuum of behavior and serves a specific role in the familiarization of animals with a new terrain.

The process of becoming familiar with an open field is broken down into four stages characterizing different degrees of conformity of rat behavior to the distinctions of the terrain. The animal starts to orient itself with regard to the properties of the "field" on the basis of its individual experience already at the start of the first stage. A complete image of the surroundings is formed only at the fourth stage of exploration thereof.

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10,657
CSO: 1840/128

UDC: 614.1:313.13:[625.1+711.168](571.5/.6)

METHODOLOGICAL ASPECTS OF STUDYING MORBIDITY AMONG WORKERS ON NEW CONSTRUCTION PROJECTS IN SIBERIA AND SOVIET FAR EAST

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 10, Oct 81
(manuscript received 22 Apr 81) pp 23-27

RADIONOVA, G. K. and KUCHERENKO, V. Z., candidates of medical sciences, Scientific Research Institute of Industrial Hygiene and Occupational Diseases, USSR Academy of Medical Sciences; and Central "Order of Lenin" Institute for Advanced Training of Physicians, USSR Ministry of Health

[Abstract] Morbidity involving temporary disability is an important factor among new arrivals to territories undergoing development, and methods of studying it are discussed as they apply to the specific conditions in such territories, where there is greater worker turnover and a higher percentage of able-bodied people (85% versus 59.8% in the nation as a whole). A socio-hygienic study was made of morbidity among workers at the Shimanovskiy Combine of the Building Industry at the industrial base of BAM [Baykal-Amur Mainline Railroad], which was started up in 1976. To obtain comparable indicators referable to year-round workers and those for newly employed workers and those who leave (worked only for part of a year) the probability theory thesis of "testing" was applied, i.e., observation of 1 man for 1 day for the study of overall morbidity or different diseases, which can then be translated into man-years. At the above combine, the highest morbidity rate was found among workers who had left the job and had worked in the main shops, but this did not apply to those in ancillary shops of the combine. It is concluded that one must include immigrant workers who spend a brief time in such territories, along with the stable resident group, to make in-depth studies of morbidity involving temporary disability. Morbidity rates were higher among new arrivals, even after 1 year of work, than local year-round workers. References: 7 Russian.
[92-10,657]

UDC: 616-08-039.57]-084.46(477-021)

ORGANIZATION OF PRELIMINARY MEDICAL EXAMINATIONS IN MAJOR INDUSTRIAL CITIES

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 11, Nov 81
(manuscript received 4 Nov 80) pp 17-20

KOZLYUK, V. M., KOBETS, G. P., BRAGA, G. F., BUKHTIYAROVA, A. T.,
ZHITNIKOVA, V. I., LIKHOGRUD, N. P., USHANOVICH, A. I. and OMEL'YANCHUK, L. I.,
Ukrainian Ministry of Health, Kiev; Donetskaya Oblast Trade-Union Council;
Donetskaya Oblast Health Department; Donetsk Medical Institute imeni M. Gor'kiy

[Abstract] On a trial basis, mass scale physicals were centralized at the municipal specialized polyclinic for preventive physicals in the city of Makeyevka, a large industrial center of the Donets Basin, with a population of 490,000. This was done to reduce loss of work time to undergo preliminary preventive physicals, improve the quality and efficiency of examinations, detection of early stages of disease, screening of patients eligible for dispensary care, lowering morbidity involving temporary disability; the above polyclinic, which was set up at Municipal Hospital No 7, was manned by redistributing medical personnel of that city. The screening procedures are listed (registration, routing through different departments--laboratory, fluorography, offices of surgeon, otorhinolaryngologist, ophthalmologist, neuropathologist, gynecologist, internist and, when indicated, as well as for individuals over 40 years old to functional diagnostic laboratory for EKG, testing of external respiration, etc.). Although this polyclinic has been functioning for a short time, it has already proven to be efficient and quality of preventive physicals has been better than at other municipal facilities. The polyclinic also offers classes to update physicians in the area of occupational diseases and occupational factors that are deleterious. Communication between different medical institutions and facilities is stressed as an important factor in improving health care, screening and prevention of diseases. Such handling of mass physicals is recommended for other public health institutions.
[88-10,657]

UDC: 313.13:616-038.86"742"

STATISTICAL EVALUATION OF RELIABILITY OF DIFFERENCES BETWEEN INDICATORS OF MORBIDITY INVOLVING TEMPORARY DISABILITY

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 11, Nov 81
(manuscript received 12 May 81) pp 28-30

BOROKHOV, D. Z., docent

[Abstract] A formula is offered to determine mean error of calculated rate of morbidity involving temporary disability, based on Poisson's distribution:

$$m = 100 \cdot \sqrt{\frac{p}{n}}$$

where m is mean error of indicator, p is mean number of cases per worker and n is the number of workers. A comparison of this method to the more laborious one previously used in a hypothetical case showed it to be simpler and as accurate. As an example, reliability of differences between indicators of morbidity for a motor vehicle shop, determined by both methods, was calculated. Another example is also offered to demonstrate the value of the new method, which is accurate enough and less time-consuming. The results of using both methods are tabulated, and the table is recommended for broad use in evaluating the indicator under discussion. References: 3 Russian.
[88-10,657]

MEDICINE

UDC 616.12-008.1-78-089.843]-07:616.155.2

FUNCTIONAL ACTIVITY OF PLATELETS DURING EARLY STAGES OF ARTIFICIAL HEART IMPLANTATION

Moscow BYULLETEN' EKSPERIMENTAL'NOY BIOLOGII I MEDITSINY in Russian Vol 92, No 12, Dec 81 (manuscript received 20 Jun 81) pp 659-661

BURYKINA, I. A., KOVALEVA, T. N., IGNATENKO, S. I., MERTSALOVA, N. N. and CHEPUROV, A. K., Laboratory of Pathophysiology; and Scientific Research Institute of Transplantology and Artificial Organs, USSR Ministry of Health, Moscow

[Abstract] Platelets are active participants in the hemostasis processes and are the first to react to changes in the vascular system. The role of platelets and their adhesion-aggregation properties was studied on 90-100 kg calves undergoing artificial heart implantation. During the narcosis, elevated adhesive activity of platelets was observed. Extracorporeal blood circulation during the first 1.5-2.5 hrs led to a lower number of platelets and their diminished activity. During the next 2-5 hrs a slight increase in aggregation and adhesion was observed which continued to increase throughout the entire experiment. A direct relationship of platelet aggregation to the concentration of fibrinogens was observed. This early increase in the activity of platelets could indicate possible development of thrombosis manifested at a later time. References 12: 2 Russian, 10 Western.
[114-7813]

UDC: 616.988.8.33.26]-078-079.4

NOSOGEOGRAPHIC VARIANTS OF TICK-BORNE ENCEPHALITIS

Moscow ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA in Russian Vol 81, No 7, Jul 81 pp 1099-1105

VOTYAKOV, V. I., PROTAS, I. I. and MOROZ, A. G., Minsk

[Abstract] This is a response to an article by K. G. Umanskiy and Ye P. Dekonenko (published in this journal in February 1980) concerning

the debate on the nosological correlation between tick-borne encephalitis (TBE) occurring in eastern and western USSR. Criteria of nosological independence of these two variants are discussed on the basis of experiments conducted on monkeys and sheep: virus level in central nervous system (experiments on sheep--elimination of virus in convalescence period in the west--Belorussian viral strain; high titers of virus until death of sheep in the east--virus strain No 198); incidence of lesions (subacute encephalomyelitis in 8.3% of sheep in the west and comatose encephalomyelitis in 100% in the east), pathomorphological changes (mesenchymal and infiltrative in the west, degeneration of ganglionic cells in the east) neuronal involvement (secondary in the west, primary in the east) and irreversibility of damage (12.5% in the west, 100% in the east). Differences were also demonstrated in incidence of different clinical forms of eastern and western TBE, on the basis of findings for Belorussian SSR and Khabarovskiy Kray. The results of statistical analysis of share of clinical forms and severity of eastern and western TBE, as well as intraregional fluctuations thereof are tabulated. It is stated that the opinion of the above-mentioned authors as to random fluctuations in incidence of different clinical forms in the eastern region (Khabarovskiy Kray) and "absolutely identical structure of clinical forms in different regions" is refuted by these studies; knowledge of such differences between the TBE forms occurring in the east and west is important to elaboration of preventive and control methods. References 29: 26 Russian, 3 Western.
[93-10,657]

UDC: 616.37-089.843-092.9

TRANSPLANTATION OF PANCREAS FROM LIVE DONOR

Moscow KHIBURGIYA in Russian No 12, Dec 81 (manuscript received 19 Sep 79) pp 50-54

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[Abstract] A study was made of structural changes in the distal fifth of the canine pancreas at different stages after allotransplantation and autotransplantation in experiments on 109 mongrel dogs weighing up to 30 kg. Segments of the transplant and viscera were taken for histological examination 3, 5, 7, 9, 14, 21 days, 1, 3, 6, 12, 24 months after surgery. At the early stage (5 days) there was marked infiltration of the glandular stroma by granulocytes and lymphoid cells, as well as areas of extensive necrosis and hemorrhages,

with intensification of these changes 7 days after surgery and encapsulation of the transplant after 9 days in the case of allotransplantation; 1 month after surgery only capsular connective tissue elements were visualized. After autotransplantation, the cellular elements of the transplant (exocrine tissue) are not distinguishable and there are severe sclerotic changes in the islands of Langerhans and wall of intraorganic vessels. Rejection of allotransplants are attributable chiefly to the vascular factor, so that vasodilating agents, anticoagulants and antienzymatic agents are apparently indicated to prolong transplant viability. After autotransplantation, there may be development of diabetes mellitus before adaptation and compensation processes terminate in the transplant. It is recommended that transplantation of a pancreatic segment as treatment of diabetes be performed with restoration of efflux of pancreatic juice, rather than ligation of pancreatic duct. In all cases attention must be given to restoring circulation in the transplant and preventing devascularization. References 14: 7 Russian, 7 Western.
[85-10,657]

UDC: 616.89-02:615.285.7.099

PSYCHOPATHOLOGY OF ACUTE POISONING BY ORGANOPHOSPHORUS COMPOUNDS

Moscow ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S. S. KORSAKOVA in Russian Vol 81, No 11, Nov 81 (manuscript received 12 Feb 80) pp 1690-1694

CHURKIN, Ye. A. and SADOVNIKOVA, L. D., Department of Acute Psychosomatic Disorders (headed by Ye. A. Churkin), Scientific Research Institute of Emergency Medicine imeni N. V. Sklifosovskiy (director--Prof B. D. Komarov), Moscow

[Abstract] A survey was made of 65 patients with acute organophosphorus poisoning ranging in age from 21 to 60 years, who were part of a group of 287 cases of such insecticide poisoning who presented an acute psychotic state. Three psychopathological syndromes were observed: psychovegetative, psychovestibular and hyperkinetic. The first of these syndromes was the first manifestation of poisoning (muscular weakness, exhaustion, inability to concentrate, emotional instability, associated with bronchorrhea, hyperhidrosis, diarrhea, bradycardia, nausea, vomiting and tenesmus). Psychovestibular symptoms constituted the second stage of toxicosis (vertigo, photophobia, moderate pain in the eyes, choking feeling, anxiety, restlessness, fear, splitting headache, visual perceptual disorders). The subsequent hyperkinetic syndrome appeared after maximum progression of the preceding one, and it was characterized by generalized muscular fibrillation (some local signs of which were also present at the start). In some cases there were some elements of all

three syndromes that could not be distinguished, so that stages of intoxication were not clearly differentiated. All psychopathological disturbances occurred only at the toxicogenic stage, in the presence of specific concentrations of the poison in blood, so that laboratory tests (mainly assay of blood cholinesterase activity) are important to diagnosing insecticide-induced acute psychosis. References: 8 Russian.
[101A-10,657]

UDC: 621.014

EFFECTS OF DESERT CLIMATE AND MEANS OF ADAPTATION OF MAN

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA BIOLOGICHESKIKH NAUK in Russian No 5, Sep-Oct 81 (manuscript received 13 Feb 81) pp 3-16

SULTANOV, F. F., Institute of Physiology and Experimental Pathology of the Arid Zone, Turkmen Academy of Sciences

[Abstract] Adaptation to high ambient temperature (40-50°C) is discussed, as compared to adaptation to 28-30°, in animals and man. A distinction is made of three phases of effects of high temperatures (euthermia, compensatory and progressive hyperthermia) and the objective is to expand the ranges of the first two. Body size, mechanisms of heat transfer and physiological features of these mechanisms are interrelated factors of adaptation; animals inhabiting hot climates are more susceptible to high ambient temperatures than those of temperate climates. The order of reactions to high temperatures is tabulated; they are referable to three main directions: activation of nonspecific hormonal and humoral reactions of the hypothalamus-pituitary-adrenal cortex system; intensification of hemodynamic system for convection transport of heat from the body's "core" to the surface; processes of dissipating heat in the environment with intensive perspiration. Such a classification permits determination of methods for compensating changes and to enhance resistance to high temperatures. Nonspecific measures include administration of hormones similar to those secreted by the adrenal cortex under stress; among others are hypoxia conditioning, conditioning by means of controlled hyperthermia, as well as intake of vitamins, physical training and others. Figures 4; references 43: 28 Russian, 15 Western.
[103A-10,657]

UDC: 616.273.3.015.4:612.822

CENTRAL EFFECTS OF TETRAPEPTIDE TUFTSIN

Moscow BYULLETEN' EKSPERIMENTAL'NOY BIOLOGII I MEDITSINY in Russian Vol 92, No 7, Jul 81 (manuscript received 16 Jan 80) pp 31-33

VAL'DMAN, A. V., KOZLOVSKAYA, M. M., ASHMARIN, I. P., MINEYEVA, M. F. and ANOKHIN, K. V., Institute of Pharmacology, USSR Academy of Medical Sciences, Moscow

[Abstract] Experiments were conducted on male mongrel rats to test the effects of tuftsin [L-threonyl-L-lysyl-L-propyl-L-arginine] on emotional and behavioral reactivity, which was assessed in "open field" tests, determining the amount of vertical and horizontal activity, number of field openings examined, active grooming, as well as use of an electrode floor to determine duration of emotional excitement after stimulation, animals' ability to hold on to a revolving bar and lift themselves up to a horizontal platform. Aversive stimuli were used to assess development and retention of passive avoidance reaction. Spectrophotometry was used to assay tyrosine hydroxylase activity and colorimetry to assay dopa concentration. Triton X-100 was used to solubilize the gross mitochondrial fraction of hypothalamus and striatum in vivo. Purified enzyme was used in the in vitro experiments. Tuftsin was used in a dosage of 500 microgram/kg and had a direct effect on tyrosine hydroxylase activity, as well as an influence on catecholamine processes in the brain. It had a definite central effect on emotional and behavioral reactions and intensification of negative motivational reactions was related to intervention of this agent in catecholaminergic processes. References 7: 3 Russian, 4 Western.
[104-10,657]

UDC: 615.47:621.382

MICROELECTRONIC ELECTRODE PROBE FOR TESTING BRAIN ELECTRICAL ACTIVITY

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 12, Dec 81 (manuscript received 9 Jun 80) pp 66-68

[Article by B. V. Zhuravlev and A. B. Simakov]

[Text] Simultaneous registration of electroencephalographic and electroneurographic activity in small parts of the brain is an important task for electrophysiology. Such measurements permit investigation of the correlation between the activity of a single neuron and neuronal populations.

Electrodes are the weak link in the equipment available for such experiments. Neurograms are usually measured by means of a glass micropipette electrode, while the electroencephalogram is taken by means of metal wire electrodes. It is difficult to check the size of such electrodes, as well as their position in relation to one another after introduction into the brain.

Technological resources of microelectronics made it possible to develop and construct a multichannel electrode probe, which combines both the micropipette and metal electrodes.

The construction of the probe is illustrated in Figure 1. The probe consists of a glass micropipette *1*, on the outer surface of which four fine-layer metal tracks *2* were formed by vacuum spraying through a stencil. The length of the track is 25 mm. A coat of insulation, silicon dioxide, 0.6 μm in thickness, was applied on the tracks by means of ion-plasma spraying. This coating is removed at the ends of the metal tracks by means of etching: on the sharp tip of the micropipette, the open metal areas form the active surfaces of electrodes *3*, and at the other end of the tracks there are contact areas *4* to connect the external contact. The housing for integral circuits of the TO-5 *5* is used as such a device. The size of active electrode surfaces is 50×50 μm and that of the contact areas is 250×250 μm.

The technological distinctions of producing the probe include a special device, the holder. Micropipettes, pressed down with a mask are situated in the grooves of the device, before spraying the metal. After spraying the metal track, the micropipette is turned 90° about its axis by means of a turning device. This makes it possible to spray the next electrode strip through the slit in the mask.

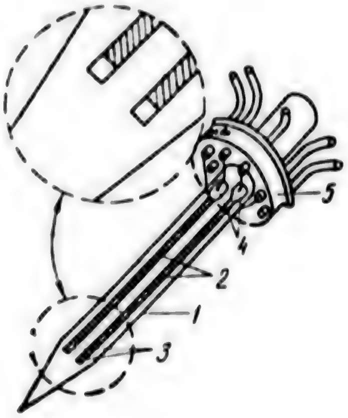

Figure 1.

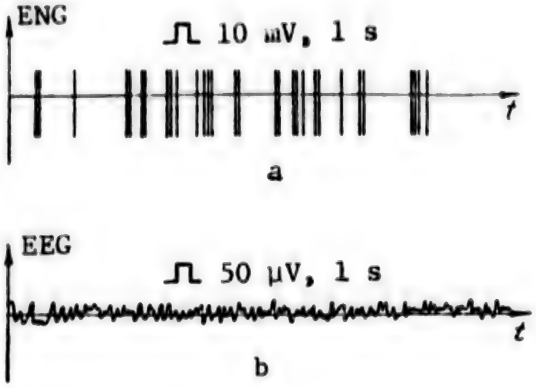

Figure 2.

Gold is used as the material for the active electrode areas. The choice of this precious metal was attributable to its inertness in a biological medium. To improve adhesion of electrode strips with backing, as well as with the insulation, three layers of metal are used: titanium--gold--titanium. The electrode strips have an overall thickness of 1 μm. The micropipette with electrodes assembled on it is secured in the housing for integral circuits, after which the outputs of the housing are connected with the contact areas of the electrodes. The contacts are coated with sealer or epoxy resin.

The polarization potential of an electrode placed in a biological medium can be estimated using a formula that relates the polarization potential to current passing through the electrode circuit [1]: $U_p = \phi_T \ln(i/i_0+1)$, where $\phi_T = kT/e = 26$ mV at 300 K; i_0 is exchange current. Exchange current is a constant that characterizes the chemical reactions occurring on the electrode in a specific electrolyte. For a gold electrode in a biological medium, the density of exchange current is 10^{-7} A/cm. For the electrodes we developed, the polarization potential was estimated at 62 mV and had an experimental value of 45 mV. In the calculations we selected current i of $3 \cdot 10^{-11}$ A, which corresponds to the difference between input power of the amplifier (microcircuit 140UD13) used for the readings.

The impedance of metal microelectrodes is capacitive, due to formation of a double electrical layer near the surface of the microelectrode [2]. The capacitance of the double electrical layer, C_e, for probe electrodes constitutes 2000 pF, while resistance to direct current R_e is over 2 MΩ.

There is a capacitive coupling between matrix electrodes, which leads to appearance of cross interference. Coefficient of suppression of cross interference K_p is defined as the ratio of magnitude of signal appearing at the output of one of the electrodes to the signal fed to the other electrode. Measurement of K_p at an input signal amplitude of 1 V and frequency of 1 kHz revealed that it did not exceed 0.01.

The main electrical parameters of the metal electrodes of the probe are: U_p = 45 mV, C_e = 2000 pF, C_p = 5 pF, R_p = 2 MΩ, r_e = 3 kΩ, K_p = 1%.

The probe micropipette is used as a microelectrode to record neuronal activity. It has the typical parameters inherent in such electrodes [2].

In trials of the probe in a physiological experiment, it was introduced through a trephination opening in the rabbit skull, into the hypothalamus. After this, its position was determined with noracryl. The external contact device makes the connection with electrodes of the measuring tract. The amplifier described in [3] was used as the EEG amplifier, while a voltage follower based on a type 140UD8 microcircuit was used at the input of the microelectrode amplifier. Figure 2 illustrates a fragment of simultaneous EEG and ENG tracings, where *a* is the electroneurogram and *b* the electroencephalogram. For these tracings, the silent electrode was situated on the rabbit's ear.

It must be noted that, along with the application described above, the electrode probe can be used in other electrophysiological studies.

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10,657
CSO: 1840/115

UDC: 612.825.262:577.352.5

FILTRATION PROPERTIES OF RECEPTIVE FIELDS OF VISUAL CORTEX NEURONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 6, Dec 81
(manuscript received 2 Jun 81) pp 1506-1509

SHELEPIN, Yu. Ye., Institute of Physiology imeni I. P. Pavlov, USSR Academy
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[Abstract] Experiments were conducted on 35 cats, in 19 of which impulsation from the 17th and adjacent portion of 18th cytoarchitectonic fields was recorded, and in the other 16 activity from the lateral suprasylvian region was recorded. The stimuli consisted of periodically oscillating grids with sinusoidal or rectangular illumination profile. Neuronal responses were evaluated on the basis of average impulsation frequency with the grid in the receptive field. Responses of tested neurons as a function of spatial frequency during delivery of stimulus to mean frequency of spontaneous impulsation as the y-axis and spatial frequencies of test grids on a logarithmic scale on the x-axis. In these tests, only the orienting-opponent spatial-frequency functions were considered as one of the general filtration properties of the receptive fields in question, and this type of reaction was demonstrated in 30 out of 60 neurons. Discrimination of spatial frequency and orientation of image was shown to be the main filtering properties of receptive fields of neurons of the visual cortex. Figures 3; references 8: 3 Russian, 5 Western.
[84-10,657]

UDC: 615.214.22.015.4:612.017.2

ADAPTOGENIC EFFECT OF MEBICAR ON EMOTIONAL TENSION, PHYSICAL EXERTION AND HYPOXIA

Moscow FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian Vol 44, No 6, Nov-Dec 81
(manuscript received 17 Nov 80) pp 654-657

KOZLOVSKAYA, M. M., OSTROVSKAYA, R. U., KLEYMENOVA, N. N., KAMYSHEVA, V. A.
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[Abstract] Adaptogenic properties of mebicar (derivative of bicyclic bis-urea, similar in action to the natural arginine-urea adaptive system) were studied in chronic experiments on 5 male cats to test its effects on behavioral reactions in the presence of heightened emotional tension, during adaptation to aversive situations and production of stress situation (avoidance of nociceptive electric stimuli), as well as on 120 male white mice placed into a pressure chamber under hypoxic conditions and 52 mongrel white male rats during performance of intensive exercise (forced swimming for 1.5 h a day for 14 days). Assays were made of lactate and pyruvate levels in brain tissue of the hypoxic mice, as well as glycogen content of the gastrocnemius before and after swimming in the rats. Such testing was prompted by reports of the tranquilizing effects of mebicar. This agent was found to improve the animals' parameters in all of the above states, but with use of different doses, which consisted of 60, 120 and 150 mg/kg: stress improved the most with 60 mg/kg, purposeful avoidance of stress situation with 60 and 120 mg/kg, overcoming obstacles with 60 mg/kg. Mebicar also had a beneficial effect on some energy metabolism processes during intensive exercise and hypoxic hypoxia, prolonging the life of animals exposed to the latter.
[91-10,657]

UDC 612.822.3 + 591.512

PLASTICITY OF CONDITIONED-REFLEX BEHAVIOR OF RATS RELATED TO INFORMATION PRESENTATION METHOD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 4, Dec 81
(manuscript received 29 Apr 81) pp 1020-1024

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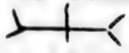
[Abstract] The search for means of optimizing brain activity under conditions of growing information loads is one of the most important tasks of current developments in neurology. The plasticity of condition-reflex behavior was studied on 30 white male rats placed in a  type labyrinth using training methods of free choice and of increasing linkage of the reflex chain. It was concluded that as the volume of initial information about a given task increased during the initial training period, so did the plasticity of the condition reflex behavior. That is, the assurance increased that an optimal solution would be found to a problem, even under conditions of various changes to the external environment. Evidently, the generalization levels and their variability were related to the extent of initial movement "alphabet" to which the animals were exposed during the first two days of familiarization with the experimental system. All following transformations related to recombination of the information fixed during the earliest phase. Figures 3; references: 3 Russian (one by a Western author).
[113-7813]

UDC: 546.28:577.170.49+591.478.001.5

PILOTROPIC ACTIVITY OF SILATRANES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 3, Jan 82
(manuscript received 9 Jun 81) pp 736-739

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[Abstract] Silatranes, which have a broad spectrum of physiological action, are derivatives of the pentacoordinated atom of silicon. Mival [1-(chloromethyl)-silatrane] and migugen [1-(ethoxy) silatrane] are of particular interest, the former have been shown to intensify nucleic acid and protein biosynthesis and, as a consequence, to stimulate formation and regeneration of connective and epithelial tissue. The fact that silicon is also involved in formation of animal pelage and human hair was also a factor leading to investigation of pilotropic activity of such compounds. Morphological and histological methods were used in experiments on guinea pigs. The compounds were tested on shaved sections of their skin and compared to control animals in whom only an ointment was used. The compounds tested were 1-alkyl, 1-alkoxy, 1-alkylthioalkyl and 1-halogenalkyl silatranes in the form of 5 and 10% ointments, the lower concentration being more effective. Mival had stronger pilotropic activity than migugen in the first tests and subsequent work was conducted chiefly with it. Ethyl alcohol and dimethylsufoxide were used as solvents for mival, and it was combined with the most popular ointment bases (vaseline and lanolin, helianthic oil and lanolin). There was substantial increase in cellular elements, blood vessels and hair follicles as a result of mival treatment, and its action is attributable to its stimulating effect on metabolic processes in the skin. References 4: 2 Russian, 2 Western.
[98-10,657]

UDC: 614.73:546.36.02.137]-074[470.314)

RESULTS OF HYGIENIC RADIATION INSPECTION OF REGION WITH INCREASED ^{137}Cs MIGRATION IN VLADIMIRSKAYA OBLAST

Moscow GIGIYENA I SANITARIYA in Russian No 11, Nov 81 (manuscript received 23 Mar 81) pp 64-66

[Article by L. N. Gavrilov, G. A. Grishina, O. N. Prokof'yev, A. V. Saburova and N. A. Tyurina, Leningrad Scientific Research Institute of Radiation Hygiene, RSFSR Ministry of Health; and Sanitary and Epidemiological Station of Vladimirskaya Oblast]

[Text] As a result of analysis of milk samples, a region with increased migration of ^{137}Cs from soil into vegetation was discovered in 1973 in Vladimirskaya Oblast, and this region was then inspected in 1973-1977. There is information in the literature to the effect that such areas of increased migration of ^{137}Cs from soil into vegetation exist in several parts of our country (A. N. Marey et al.; I. V. Gulyakin and Ye. V. Yudintseva).

Our main objective in this survey was to determine the take of ^{137}Cs with food and evaluate internal irradiation of children and adults living in the region of increased ^{137}Cs migration.

Inspection of this region revealed that it has peat-bog, soddy, moderately and strongly podzolic and sandy loam soil with high-standing subsoil waters. Sand is the predominant fraction. According to data of the oblast agrochemical laboratory, the mean agrochemical parameters of soil in this region are as follows: humus 1.86%, hydrolytic acidity 3.06 mg-eq/100 g soil, total absorbed bases 4.13 mg-eq/100 g soil, saturation 55.1 mg-eq/100 g soil and pH of soil solution 4.2-5.2. Hence, the soils have low absorption, low pH of soil solution, low humus level. ^{137}Cs undergoes chiefly metabolic, reversible reactions in such soil and it migrates readily from soil into plants (I. V. Gulyakin and Ye. V. Yudintseva). This results in higher accretion of ^{137}Cs in the next links of the biological chain: vegetation, meat and milk of productive animals, man. Table 1 lists the mean concentrations of ^{137}Cs in the top soil of the inspected and control areas as determined from analysis of samples. As a control, we selected a region where the concentration of ^{137}Cs in milk and meat of productive animals was close to the average for the Soviet Union.

Table 1 shows that the concentrations of ^{137}Cs are the same in top soil of the surveyed (with high migration) and control (ordinary) areas. According to the results of our analyses (Table 2), the concentration of ^{137}Cs is 13-21 times greater in hay from the region with increased migration than in hay from the control region.

Table 1.
Mean concentrations of ^{137}Cs (pCi/kg air-dried mass) in top soil of region with increased migration and control region (M±m)

Year	Region	
	Studied	Control
1973	130±20 (3)	—
1974	340±50 (4)	—
1975	310±30 (10)	—
1976	210±20 (16)	210±60 (3)
1977	170±20 (11)	210±30 (11)

Note: Here and in Tables 2-4, the number of samples taken each year is given in parentheses.

Table 2.
^{137}Cs concentration (pCi/kg) in hay (M±m)

Year	Region	
	Studied	Control
1973	1900±100 (3)	90±40 (1)
1974	1500±400 (3)	—
1975	1300±100 (2)	—
1976	1300±200 (5)	100±10 (2)

Table 3.
Concentration of ^{137}Cs (pCi/ℓ) in milk from cows in farms with increased migration (M±m)

Farm	Cattle upkeep	
	Indoors	Outdoors
1	62±4 (8)	130±10 (18)
2	210±30 (9)	240±30 (10)
3	80±20 (8)	130±10 (20)
4	150±20 (8)	300±20 (12)
5	50±10 (6)	64±8 (7)

Table 4.
^{137}Cs concentration (pCi/ℓ) in urine of children living in region of increased migration (M±m)

Year	Winter	Summer
1975	30±2 (6)	73±8 (6)
1976	35±1 (6)	94±4 (6)

The concentration of ^{137}Cs in cow's milk on different farms in the region of increased migration differed substantially (Table 3). During the period of indoor upkeep [in barns], there is 1.5-2 times less ^{137}Cs in milk of cows on all farms than during the period of outdoor [pasture] upkeep. This is attributable to the fact that the winter diet of animals (indoor upkeep) causes less intake of ^{137}Cs due to inclusion of silage, concentrates and straw than the summer diet when the cattle graze out of doors. According to the results of analysis of 70 milk samples from cows on farms in the control region, the ^{137}Cs concentration is 10±1 pCi/ℓ during indoor upkeep and 14±1 pCi/ℓ during the period of pasturage, i.e., it is 5-20 times less than in the milk of cows on farms in the region with increased migration.

The correlation between concentration of ^{137}Cs in muscle tissue and milk of cows is the same for the region of increased migration and control region, constituting a mean of 2.5 to 2.8. It should be noted that there are rather considerable individual differences in ^{137}Cs concentration in muscle tissue of animals in the region of increased migration, ranging from 0.07 to 2 nCi/kg. There is a narrower range of variation in ^{137}Cs content of milk samples collected from the region of increased migration. This is attributable to partial equalization of ^{137}Cs concentration in milk when milk from different cows is poured into the same large container. The mean ^{137}Cs content in urine of children 2 to 7 years of age living in the region of increased migration changed similarly to the level in milk with the change from winter to summer (Table 4).

Our analysis failed to demonstrate reliable age- and sex-related differences (between children 2-4 and 4-7 years of age) in concentration of ^{137}Cs in urine. Individual differences in excretion of ^{137}Cs in urine were analyzed in six children in a group living at a children's combine. In these children, minimal daily excretion of ^{137}Cs in urine constituted 7 pCi and the maximal was 33 pCi. According to measurements, the mean concentration thereof in adult urine is 1.14 times greater than in children 2-7 years of age. Mean ^{137}Cs level in urine of adults living in the control region constituted about 14 pCi/ℓ. The ratio of ^{137}Cs concentration in milk to concentration in urine of children 2-7 years of age constituted about 1.8 in the region of increased migration, and it did not change with the change from winter to summer. This indicates that the principal constitutents of the diet in this region which caused intake of ^{137}Cs by children 2-7 years of age were the milk and meat of cattle. When there is equilibrium between intake and elimination of ^{137}Cs, its concentration in a 7-year old child was 1.8 times lower than in an adult (Yu. S. Belov et al.). At the same time, intake of ^{137}Cs with food by an adult was 1.5-2 times higher (average 1.8 times higher) than by a preschool child (E. V. Petukhova). Using the equation that determines the link between ^{137}Cs content of the body and daily intake with food in the case of equilibrium, as well as the above-mentioned data, we obtained the following equation for calculation of the half-life of ^{137}Cs for a child:

$$T_c = T_a \frac{M_c}{M_a} \qquad (1)$$

where T_c and T_a are the half-lives for a child and adult, respectively; M_c and M_a are the weight of a child and an adult.

One can calculate the half-life of ^{137}Cs for a child(on the basis of weight (70 kg) and half-life of 70 days (A. A. Moiseyev and P. V. Ramzayev) for an adult) using equation (1). With a child weighing 20 kg this period equals 20 days. In the case of equilibrium, mean daily intake of ^{137}Cs equals its mean daily elimination. Mean daily elimination of ^{137}Cs by man constitutes $1.32 \cdot q_u$ (A. A. Moiseyev and P. V. Ramzayev), where q_u is mean daily excretion of ^{137}Cs in urine. Mean daily elimination of ^{137}Cs by a child in urine constitutes $C_u V_u$, where C_u is concentration of ^{137}Cs in urine and V_u is mean daily volume of urine. According to our data, in children 2 to 7 years of age, $V_u \approx 0.41$ ℓ.

The absorbed dose of incorporated ^{137}Cs was calculated using the following equation:

$$D = 9 \cdot C_b \qquad (2)$$

where D is absorbed dose (mrad/year) and C_b is concentration in the body (nCi/kg). The concentration of ^{137}Cs in the body was calculated using the following formula:

$$C_{b_{a(c)}} = T_{a(c)}\ 1.32 \cdot C_u V_u / 0.693 \cdot M_{a(c)} \qquad (3)$$

Maximum mean Cs concentration in milk constituted 0.3 nCi/ℓ (see Table 3, farm 4). With intake of such milk, the concentration of ^{137}Cs in children's urine would constitute $0.3 \div 1.8 = 0.167$ nCi/ℓ and in adult urine $1.14 \cdot 0.167 = 0.19$ nCi/ℓ. According to equations (2) and (3), the absorbed doses would constitute 1.2 and 4.6 mrad/year for children and adults, respectively. In our calculations, it was considered that mean 24-h urine volume constituted 1.4 ℓ for adults.

The ^{137}Cs from milk and muscle tissue samples was concentrated by means of evaporation, burning and ashing at temperatures not exceeding 450°C, as well as by means of sorption concentration on KSM and ShSM silica gel. Nickel ferrocyanide was used to concentrate ^{137}Cs from urine samples. After concentrating it, the ^{137}Cs was transferred to a hydrochloric acid solution, from which it was isolated by the antimonous iodide or tellurite method. We measured the impulse rate in isolated sediment of antimonous iodide or hexachlorotellurite salts with stable ^{137}Cs using a UMF-1500 radiometry unit with SBT-13 counter. The main contribution to error of assaying ^{137}Cs was referable to possible deviations from the most likely indicators of degree of migration of ^{137}Cs in processes of concentration and radiochemical isolation. This error was estimated at 20%.

Conclusions

1. When there is the same density of cumulative sediment of ^{137}Cs in soil of the region with increased migration thereof, the concentration of ^{137}Cs in hay was 13-21 times higher than in an ordinary region and in milk and muscle tissue of cattle it was 5-20 times higher.

2. There are differences between individual indicators of daily excretion of ^{137}Cs in urine of children consuming the same diet. No reliable differences were demonstrated between mean concentration of ^{137}Cs in urine of children as a function of sex and age in the age groups of 2-4 and 4-7 years.

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CSO: 1840/109

UDC: 577.391:621.039.58

POTENTIATION OF PROTECTIVE ACTION OF SULFUR-CONTAINING RADIOPROTECTIVE AGENTS

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 6, Nov-Dec 81 (manuscript received 30 Jun 80) pp 836-840

[Article by V. G. Vladimirov, T. G. Zaytseva and S. M. Smirnova]

[Text] A study was made of the radioprotective action of formulas consisting of cystamine or aminopropyl aminoethylthiophosphoric acid and thiourea derivatives--gutimine or ethyrone--in experiments on mice. It was demonstrated that the radioprotective action of these formulas given intraperitoneally 20 min prior to total-body irradiation by γ-rays in a dosage of 7.5 Gy, as assessed by animal survival rate, number of endogenous colonies in the spleen and cellularity of bone marrow, was considerably greater than cystamine and aminopropyl aminoethylthiophosphoric acid given separately.

In recent years, potentiation of radioprotective action was discovered when various sulfur-containing protective agents were used together [1, 2]. This phenomenon drew attention, since it opens the way for development of highly effective protective combinations of radioprotectors of the same class, but used in lower doses than the conventional ones when they are used separately. One can thus expect a decrease in side-effects, which are observed in many sulfur-containing radioprotective agents when given in optimum radioprotective doses. Our objective here was to investigate the potentiation effect of combined use of cystamine or aminopropyl aminoethylthiophosphoric acid (APAETP) and some derivatives of thiourea.

Material and Methods

Experiments were conducted on male white mongrel mice weighing 19-22 g. We used the following derivatives of thiourea as a second component: ethyrone (HBr), methyrone (HBr) and gutimine [guanyl thiourea]. We selected these products in a desire to reduce the side-effects of cystamine and, first of all, its hypotensive action (as we know, ethyrone and methyrone are referable to hypertensive agents [3]). Ethyrone's capacity to enhance radioprotective activity of cystaphos was demonstrated previously [1]. Gutimine was used as an antihypoxant [4-5], since it is known that sulfur-containing radioprotective agents can block respiratory activity of mitochondria and induce cellular hypoxia [6-8]. These products were given to mice intraperitoneally 20 min prior to exposure to γ-quanta in a dosage of 7.5 Gy (dose rate 0.4 Gy/min). The protective effect of radioprotective agents and combinations thereof was evaluated on the basis of 30-day postradiation survival, number of endogenous colony-forming units (CFU) in the spleen [9] and number of nuclear cells in bone marrow of the femur. The graph method of Loewe [10] was used to determine the optimum combination with maximum protective effect and lowest dose ratios. Median effective (ED_{50}) and median lethal (LD_{50}) doses were calculated by the method of probit analysis.

Results and Discussion

Preliminary experiments revealed that gutimine, ethyrone and methyrone cause survival of no more than 50% of mice exposed to radiation in the minimum absolutely lethal dose, when they were used separately. Optimum protective doses (which virtually corresponded to ED_{50}) of these agents constituted 360, 47 and 10 mg/kg (for salt) and were used to plot isobolae of the radioprotective effect on isodynamic diagrams. Figure 1 illustrates isobolae of the radioprotective effect of two-component mixtures based on cystamine, where the shares of ED_{50} of the tested thiourea derivatives are plotted on the y-axis and shares of ED_{50} of cystamine on the x-axis. The summation line that connects the two extreme points of the axes separates isobolae characterizing potentiating and antagonistic action. An analogous study was made with mixtures based on APAETP. The data illustrated in Figure 1 indicate that there is potentiation of radioprotective action of APAETP in all combinations with the tested thiourea derivatives (true, to varying degrees: gutimine > ethyrone > methyrone).

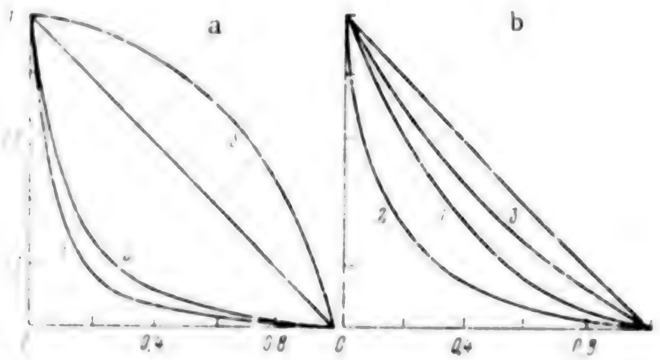

Figure 1. Radioprotective activity of cystamine (a) and APAETP (b) combined with ethyrone (1), gutimine (2) and methyrone (3) used in different dose ratios. X-axis, doses in fractions of ED_{50} (a--cystamine, b--APAETP); y-axis, doses of ethyrone, gutimine and methyrone in fractions of ED_{50}

The results revealed that the maximum effect was obtained with a combination of cystamine or APAETP with ethyrone and gutimine. For this reason, we subsequently conducted a more comprehensive study of expressly these complexes. The optimum doses of gutimine and ethyrone that potentiated the radioprotective effect constituted, according to Figure 1 (a and b), 100 and 5 mg/kg, respectively. Experiments revealed that the most marked potentiation effect was demonstrated with the combined use of APAETP and gutimine. In this case, the ED_{50} of APAETP dropped to one-sixth (Table 1). In combination with ethyrone, ED_{50} of cystamine and APAETP dropped to about one-half. Analogous changes were demonstrated in evaluation of optimum protective doses (ED_{90}) of radioprotective agents combined with gutimine and ethyrone. ED_{90} of cystamine and APAETP against the background of these products dropped by 1.2-1.5 times (Table 2). We were impressed by the relatively low overall dosage of mixtures containing ethyrone: 100 mg/kg with the use of cystamine and 80 mg/kg with APAETP.

Table 1. Effect of gutimine (100 mg/kg) and ethyrone (5 mg/kg) on radioprotective activity and toxicity of cystamine and APAETP in experiments on mice

Agents	Number of mice	ED_{50}, mg/kg		Number of mice	LD_{50}, mg/kg		LD_{50}: ED_{50}
		$M \pm m$	P		$M \pm m$	P	
Cystamine	40	69±2	—	40	250±12	—	3,7
Cystamine + gutimine	30	33±5	<0,05	40	214±10	<0,05	6,5
Cystamine + ethyrone	30	30±9	<0,05	40	295±15	<0,05	9,8
APAETP	30	60±9	—	40	412±20	—	7
APAETP + gutimine	30	10±4	<0,05	40	250±15	<0,05	25
APAETP + ethyrone	30	30±6	<0,05	40	375±29	>0,05	12

Table 2. Changes in maximum tolerance and radioprotective doses of sulfur-containing radioprotective agents under the influence of ethyrone (5 mg/kg) and gutimine (100 mg/kg)

Agents	Number of animals	SD_1, mg/kg	Number of animals	ED_{90}, mg/kg	Safety index (SD_1:ED_{90})
Cystamine	40	190	40	150	1,3
Cystamine + gutimine	40	160	40	110	1,5
Cystamine + ethyrone	40	210	40	100	2,1
APAETP	48	230	40	100	2,3
APAETP + gutimine	36	170	40	80	2,1
APAETP + ethyrone	36	210	40	80	2,6

Examination of the toxicity of two-component mixtures revealed that gutimine enhanced somewhat the toxicity of the radioprotective agents, whereas ethyrone, on the contrary, had a beneficial influence on this parameter. It was usually the most marked in combination with cystamine. This was indicated by the values of minimum tolerance (SD_1) and medial lethal (LD_{50}) doses. As a result, the breadth of the radioprotective effect and index of mixture safety increased distinctly (Table 2). Thus, with the use of gutimine and ethyrone in the mixtures, it was possible to lower the dosage of cystamine and APAETP without altering their efficacy.

Since the outcome of radiation damage depends significantly on the condition of bone marrow, a comparative study was made of the protective action of the tested mixtures as assessed by the parameter of endogenous colony formation in the spleen and number of myelokaryocytes in bone marrow of irradiated animals. As can be seen in Figure 2, the level of protection obtained with the use of mixtures and assessed by the number of CFU in the spleen and nuclear cells in bone marrow was either the same or even greater than the protective effect of cystamine and APAETP used separately in optimum protective doses. Thus, the mixtures studied have a substantial protective effect on the hemopoietic system.

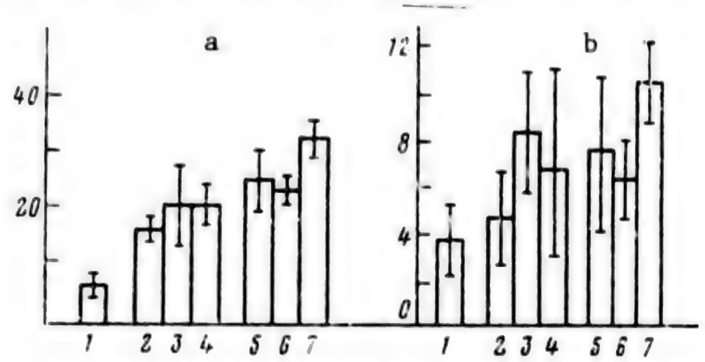

Figure 2. Effect of cystamine, APAETP and mixtures thereof with thiourea derivatives on colony formation in the spleen (a) and on cellularity of bone marrow (b).
Y-axis: a) CFU units b) number of nuclear cells, millions
X-axis--products and mixtures:
1) irradiation in dosage of 7.5 Gy
2) cystamine, 150 mg/kg
3) cystamine, 75 mg/kg, + gutimine, 100 mg/kg
4) cystamine, 75 mg/kg, + ethyrone, 5 mg/kg
5) APAETP, 100 mg/kg
6) APAETP, 60 mg/kg, + gutimine, 100 mg/kg
7) APAETP, 60 mg/kg, + ethyrone, 5 mg/kg

Table 3. Effect of agents and combinations thereof on arterial pressure of mice

Agents and combinations	Dose, mg/kg	Arterial pressure (mm Hg) 30 min after giving agents
Saline	--	88±2
Cystamine	150	60±6
APAETP	100	84±2
Ethyrone	5	113±6
Methyrone	5	110±4
Gutimine	100	122±7
Cystamine + ethyrone	100 5	122±7
Cystamine + methyrone	100 5	100±2
Cystamine + gutimine	100 100	100±10
APAETP + ethyrone	80 5	125±7
APAETP + methyrone	80 5	115±5
APAETP + gutimine	80 100	110±10

Systemic hemodynamic changes could play some part in the protective action of a number of radioprotectors. Since the mixtures we tested contained agents that had an influence in different directions on the cardiovascular system (for example, cystamine has hypotensive action, whereas ethyrone and methyrone, on the contrary, have hypertensive action), it was important to determine the role of this mechanism in the protective effect. Experiments revealed that the adrenolytic action of cystamine used in the mixture was cancelled and, moreover, a hypertensive effect appeared (Table 3). Mixtures based on APAETP had an analogous, but less marked effect. Nevertheless, we failed to demonstrate a distinct correlation between protection and hypertensive effects of the tested mixtures.

The general conclusion of this work is confirmation [1, 2] of the possibility of potentiating the radioprotective effect by combining different sulfur-containing products. However, further investigation must be made of the more detailed mechanisms of this phenomenon.

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EFFECTIVENESS OF APPLICATION OF VARIOUS RADIOPROTECTORS FOR PROTECTION OF REPRODUCTIVE CELLS OF MALE MICE FROM GENETIC EFFECTS OF RADIATION, REPORT II: FREQUENCY OF RECIPROCAL TRANSLOCATION IN SPERMATOGONIA

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[Abstract] A study is made of the protective effect of certain radioprotectors as measured by the frequency of radiation-induced reciprocal translocations in mouse spermatogonia. Compounds which have demonstrated effectiveness in preventing radiation-induced, dominant lethal mutations were tested. Male hybrid mice 2.5-3 months of age were irradiated once with a dose of 77.4 mC/kg (300 R), dose rate 1.935 mA/kg (450 R/min). Fifteen minutes before irradiation, 0.2 mℓ of an aqueous solution of each radioprotector was administered intraperitoneally. Substances tested and doses included: cistaphos, 200 mg/kg; gammaphos, 150 mg/kg; cystamin, 150 mg/kg; 5-MOT, 21 or 62 mg/kg; ATP, 50 or 150 mg/kg; cystamin, 150 mg/kg plus 5-MOT, 21 mg/kg; ATP, 50 mg/kg plus cystamin, 150 mg/kg; ATP, 50 mg/kg plus cystamin, 150 mg/kg plus 5-MOT 21 mg/kg; a mixture of six components (gammaphos, sistaphos, AET, cysteine, aminoethylthiosulfuric acid, thioglycolic acid acetylhydrazide; finally, ATP, 50 mg/kg plus the mixture of six components. The mice were sacrificed on the 45th day and the frequency of radiation-induced reciprocal translocations studied. Sistaphos, gammaphos and the combination of cystamin plus 5-MOT were found to decrease frequency of reciprocal translocations in the spermatogonia. The protective factor varied from 0.29 to 0.38. Sistaphos was also effective at a higher radiation dose. Cystamin plus the mixture of six components showed a tendency toward protective effect. 5-MOT was more effective at 21 mg/kg than at 62 mg/kg. ATP was ineffective. References 19: 12 Russian, 7 Western.
[112-6508]

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PROBLEMS OF INDICATION OF RADIORESISTANCE MODIFIED BY PROTECTORS, REPORT III: RELATIONSHIP OF HYPOXIC AND RADIOPROTECTIVE EFFECTS IN RAT BONE MARROW WITH HYPOXIA PRODUCED BY VARIOUS CAUSES

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 6, Nov-Dec 81
(manuscript received 19 May 80) pp 847-853

ROZHDESTVENSKIY, L. M.

[Abstract] The reliability of the hypoxia index as a quantitative indicator of the radioprotective effectiveness of various protectors which cause hypoxia depends primarily on two factors: the specific share of the hypoxic method of protection in the overall mechanism of the protector, and the adequacy of assay of the actual concentration of oxygen near the target molecules obtained by a macroelectrode during polarographic pO_2 measurements. The first of these questions was answered by comparing the variation of effect as a function of ΔpO_2 for various protectors producing circulatory and hemic hypoxia. An approach to an answer to the second question was achieved by estimating the agreement of the variation of effect as a function of oxygen partial pressure with the curve of the oxygen effect obtained in vitro with a strictly defined O_2 concentration in the environment surrounding the cell. Experiments were performed on nembutal-narcotized male rats subjected to total and uniform X-ray irradiation at 700 R. Protectors studied included mexamine hydrochloride, adrenalin hydrochloride, noradrenalin hydrochloride, paraaminopropiophenone and sodium nitrite. The relationship of radioprotective effect to hypoxic effect can be expressed, for mexamine, adrenalin, noradrenalin, PAPP and hypoxic hypoxia, by a single curve. The hypoxic mechanism is seen to be the leading mechanism in the radioprotective effect of these protectors. It is demonstrated that the oxygen concentration in bone marrow tissue changes as radiosensitivity changes in accordance with patterns established and studies of the oxygen effect on cell cultures. Differences in the method of measurement of O_2 content in the tissue, in general, and differences in the chemical specifics of the protector causing hypoxia, in particular, are insignificant, though the rate of decrease in O_2 is apparently significant. The rate of rapidly developing hypoxia considering the time factor is thus a reliable quantitative indicator of increased radioresistance of the tissue in which the effect appears. Figures 4; references 18: 9 Russian, 9 Western.
[112-6508]

UDC: 577.391

SPECIES RADIOSENSITIVITY OF MAMMALS

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(manuscript received 25 Mar 80) pp 879-883

TIKHONCHUK, V. S., GALKIN, A. A. and KARPOV, V. N.

[Abstract] Data published in previous works were used to obtain inter-species ratios of physiologic parameters among man, dog, rat and mouse. A model was created of species sensitivity as a function of the physical parameters of the biological species. From other reports, published earlier, threshold values were taken of power density and time of microwave irradiation for mice, rats and dogs which cause 0.1% lethality. These data, used as interspecies ratios, were utilized to test the suitability of the model generated and to determine the possibility of predicting modification of a physiologic parameter. Figures 2; references 12: 9 Russian, 3 Western.
[112-6508]

UDC: 577.391:621.039.58

RADIOPROTECTOR EFFECT OF CYTOTOXIN FROM VENOM OF CENTRAL ASIAN COBRA AND CERTAIN ASPECTS OF ITS MECHANISM OF ACTION

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(manuscript received 23 Jun 80) pp 918-922

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[Abstract] A study is made of the radioprotector effect of a cytotoxin, one of the main components of the venom of the Central Asian cobra (Naja oxiana Eichwald). Experiments were performed on 300 mice, 300 male rats and on rabbits (all animals irradiated by ^{60}Co gamma radiation). The cytotoxin was administered intraperitoneally as an aqueous solution, its effectiveness judged by the clinical course of acute radiation sickness, 30 days survival rate of the animals and total duration of life. Preliminary administration of the cytotoxin clearly increased the radiation resistance of the animals, increasing survival rate from 2-4% to 12-14% at 30 days. The protective effect was manifested as an elongation of survival time by 4 to 5 days and moderation of the clinical course of acute radiation sickness. Prophylactic application of the cytotoxin in lower doses (100 to 300 µg/kg) was less effective than the higher dose of 1.0 mg/kg. Protection of the processes of synthesis of DNA,

RNA and protein played an important role in the radioprotector effect; these systems are under the control of the cyclic AMP system. When whole venom is used instead of the cytotoxin alone, a dose of 0.15 mg/kg is effective, indicating possible synergism among its individual components, though the cytotoxin is the main protector. References 13: 7 Russian, 6 Western.
[112-6508]

UDC: 577.391:616-001.17:591.111

CHANGES IN CONTENT OF SODIUM AND POTASSIUM IONS IN PLASMA AND ERYTHROCYTES FOLLOWING COMBINED RADIATION AND THERMAL INJURY

Moscow RADIOBIOLOGIYA in Russian Vol 21, No 6, Nov-Dec 81
(manuscript received 3 Mar 80) pp 922-924

KHREBTOVICH, V. N.

[Abstract] A study was made of changes in the concentration of sodium and potassium ions in the blood plasma and erythrocytes of 25 dogs which had been subjected to thermal burns (over 12 to 15% of the body surface) plus exposure to whole body uniform gamma radiation at 1.5 Gr. The plasma and erythrocytes were studied before the experiment and 1, 3, 5, 10, 15 and 20 days after the double trauma of burn and whole body irradiation. Unique changes occurred in the content of sodium and potassium ions in the blood plasma and erythrocytes: for 20 days after the trauma, the content of the electrolytes decreased. However, statistically significant changes were revealed during the period of greatest manifestation of either the burn effect (the first days) or at the height of the radiation disease (10-15 days). During the first few days, there was a decrease in the quantity of sodium and potassium in both plasma and erythrocytes, not resulting from burn trauma, for which ionic asymmetry between cellular and acellular fluid is typical. Burns in combination with radiation sickness produced unique disorders of electrolyte equilibrium manifested as a decrease in both sodium and potassium in intracellular and extracellular sectors of the organism. References 10: 9 Russian, 1 Western.
[112-6508]

UDC: 581.184.45

FORECASTING CHANGES IN ANIMAL RADIORESISTANCE CAUSED BY DIFFERENT FACTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA BIOLOGICHESKAYA in Russian No 6, Nov-Dec 81 (manuscript received 18 May 81) pp 891-897

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[Abstract] Experiments were conducted on 600 CBA and CBAxC_{57}Bl(F_1) hybrid mice, as well as 120 Wistar and mongrel white rats exposed to total body gamma radiation from cobalt and cesium sources (6.75-9.0 Gy at dose rates of 0.006 to 0.06 Gy/s) and additional factors--gravity stress induced by rotation in a chamber producing centripetal, precession and Coriolis accelerations affecting mainly the receptor endings of the vestibule and semicircular canals, high noise background, low ambient temperature, artificial illumination for 12 h periods alternating with darkness and alteration of usual upkeep conditions; injection of saline, novocaine, ascorbic acid 15-20 min prior to irradiation, as well as a simulated injection. Survival rate after irradiation was 70% in the control and much lower after injections or simulated injection. Exposure to gravity factors increased postradiation survival rate. Usual feed and upkeep conditions prior to irradiation, as well as exposure in less crowded cages, resulted in higher survival rates. Neurological organization, type of higher nervous activity, corticosubcortical correlations that form the base functional reaction background are involved, along with radiation dose level, in the range of medium lethal and close to absolutely lethal doses, which are involved in the outcome of radiation damage. The implications for space biology and medicine are discussed. References: 22 Russian.
[102A-10,657]

UDC: 612.821.1/.3-058

NATURAL AND SOCIAL DETERMINATION OF HUMAN PSYCHE

Moscow VESTNIK AKADEMII MEDITSINSKIKH NAUK SSSR in Russian No 4, Apr 81 (manuscript received 30 Oct 80) pp 56-65

[Article by G. I. Tsaregorodtsev and N. I. Gubanov (Moscow—Aktyubinsk)]

[Text] For the last two decades, Soviet philosophers, psychologists and biologists have been discussing [debating] the question of natural determination of man's mental development, the role of biological and social factors in the inception and development of consciousness and thinking (see articles by S. L. Rubinshteyn, A. N. Leont'yev, D. I. Dubrovskiy, E. V. Il'yenkov, P. N. Fedoseyev, B. F. Lomov, N. P. Dubinin and others in the journals, VOPROSY PSIKHOLOGII [Problems of Psychology], Nos 1, 3, 5, 1960 and VOPROSY FILOSOFII [Problems of Philosophy], Nos 8, 11, 1968; No 3, 1969; Nos 7-9, 1970; No 12, 1971; No 9, 1972; Nos 3, 4, 1976, No 2, 1977; No 11, 1979, as well as the collections, "The Personality," Moscow, 1971, "Correlation Between Biological and Social Factors in Man," Moscow, 1975, "Biological and Social Factors of Human Development," Moscow, 1977). There are particularly major debates on the question of mental capabilities. The alternative formulation of the question of natural and social determination of the human psyche is moving farther and farther into the past, giving way to the thesis that the human psyche develops on the basis of natural preconditions under the deciding influence of social factors. Our objective here was to try to define some aspects of the problem of determination of human capacities.

Formulation of conceptions of the nature of capacities occurred in the struggle between two extreme concepts--biologizational and sociologizational. The position developed as a result of this struggle by most authors involved in discussing the problem consists of the fact that the capacities of an individual are formed and developed in the course of his life under specific social conditions. At the same time, the preconditions for capacities (or inclinations) are genetically determined (K. K. Platonov, 1970; B. F. Lomov, 1976; A. V. Brushlinskiy, 1977). Proceeding from the results of discussion of the problem of capacities, it can be concluded that formation of mental capacities of each man is possible as a result of existence of both genetic inclinations, represented by a specific level of morphological structure of the brain and appropriate social conditions and factors (instruction, object-related activities, communication) which are instrumental in realizing inclinations and transforming them into capacities by means of formation of the appropriate neurodynamic organization. One should not overlook the fact that inherited inclinations themselves arise in the course of biosocial selection, i.e., under the influence of social factors. "Internal conditions, with which the effects on the personality are mediated at each point in time, were formed, in turn, in relation to prior external influences" (A. V. Brushlinskiy, 1977).

With reference to structure and organization of the brain, we make a distinction between the concept of "structure" and "organization." "The composition or orderliness of elements of a system that is stable (invariant) in relation to very definite changes (transformations) is called structure. The concept of organization contains the concept of structure plus unstable (changing) orderliness of elements" (V. S. Tyukhtin, 1976). The structure of the brain is formed in the course of anthropogenesis, and it is genetically determined, whereas its concrete organization is formed on the basis of this structure, already in the course of individual development.

Both heredity and the environment are important to individual development of man. It is only with knowledge about both components that the spiritual wealth of each man, his creative potential, can be totally revealed. Without knowledge of the genetic basis of man, one cannot realize to the full extent the highly humanistic principle of "from each according to his capacities, to each according to his needs." Genetically determined elements of mental activity, emotional reactions and capacities can be improved or worsened by the environment. "This puts to human genetics, to psychology and pedagogics a complex but exceptionally important social problem, that of defining man's capacities and inclinations at an early age. Solution thereof will make it possible to implement vocational training of each man on the basis of his inherent profile of giftedness, in the best possible way, with due consideration of the interests of man and society" (V. D. Timakov and N. P. Bochkov, 1973). However, a methodological set on exclusively social determination of the psyche does not permit consideration of man's individual distinctions in vocational training and thus does not permit achieving his maximum efficiency.

When considering the problem of social and natural determination of human capacities, one must make a distinction between two aspects: 1) formation in the course of anthropogenesis of inclinations for mental activity that are transmitted over the channels of genetic heredity; 2) realization of inclinations in the course of man's individual development and formation of capacities on their basis. If these aspects are confused, additional difficulties arise in solving the problem under discussion. Capacities (in spite of idealism) are not only expressed, but formed in the course of activity, training and communication. Unlike capacities proper, inclinations (in spite of mechanicism) are not so much formed as expressly manifested in the course of activity of an individual, existing from the start as its internal prerequisite before and independently of it. Formation of inherited inclinations occurred in the course of biosocial selection.

What is methodologically the most important aspect of the problem under discussion is the Marxist thesis that human nature is a product of history: as he changes the environment in the course of his practical endeavors, man "at the same time changes his own nature".[1] This classical thesis of K. Marx is basically incompatible with any version of dualistic interpretation of the correlation between biological and social factors in man, including the thesis of gradual "ejection" of the biological element by the social one. As validly observed by P. N. Fedoseyev (1976), in commenting on the above thesis of K. Marx, "in the course of social activities, man expressly changes, but does not cancel, does not eliminate the natural, biological element within him. For this reason, the correlation, the succession between biological and social elements does not disappear, but develops historically."

The Marxist thesis of the nature of man as the product of history can be made specific ["concretized"] in modern theory of biosocial selection. Biosocial selection (Yu. I. Semenov, 1974), or harmonizing evolution (N. P. Dubinin, 1977, 1979), as a mechanism of anthropogenesis, fills the "orders" of industrial activity and constitutes selection of forming social groups engaged in industrial work, rather than selection of individuals. With such selection, collective labor, thinking and language are factors of both social and still continuing, progressive biological evolution. The prehominid was unable to produce work tools because of his physiological organization. For this reason, industrial work should, as it developed, have reached a contradiction, at a certain stage, with the morphophysiological organization of man and make it necessary to alter it. Just as inevitably, it had to be in contradiction with the animal form of reflection of the world and animal method of communication, rendering it objectively necessary for the inception of thinking, will and language. This is how the necessity arose for morphophysiological and mental organization of prehominids to be transformed into human forms of biological and mental organization, which made it possible to perform industrial activity with success. This transformation was the content of harmonizing evolution of prehominids. It occurred by means of selection of groups, rather than individuals, since industrial activity and better ability to perform it gave an advantage in the struggle with nature to an entire group, rather than to skillful performers individually, and only to such a group. The mechanism of harmonizing evolution had purely genetic bases in the form of selection of mutations and recombinations. However, the direction of this group selection was determined by the requirements of social work of individuals. As a result of harmonizing evolution the physical image and anatomical-physiological distinctions of man emerged.

Along with transformation of the entire organization of the human body in the course of biosocial selection, there was also transformation of the neurophysiological basis of man's mental activity. The property of mental reflection developed and improved as a result of predominant survival of groups the individuals in which had a better developed psyche necessary to work and communication, thus causing the transition from animal psyche to human consciousness. The neurophysiological structures of the brain involved in more adequate mental reflection are genetically fixed; they can be transmitted from generation to generation via the channels of genetic heredity. The appropriate neuromorphological brain structure, on the basis of which a concrete organization of the brain is established in the course of an individual life, constitutes the natural condition for inception of the consciousness of each man. This natural condition emerges as the presence of inherited inclinations for specifically human activities. Thus, "the inclinations of a child are the product of long-term evolution, which is contained in genetically fixed 'codes'" (A. G. Spirkin, 1972).

We feel there is no validity to the efforts made by some authors (A. N. Leont'yev, 1975; E. V. Il'yenkov, 1977; N. P. Dubinin, 1977, 1979) to deny the existence of inherited intellectual inclinations, i.e., innate determination of the human psyche, and to recognize only its social determination.[2] K. Marx wrote: "Man is directly a natural being. As a natural being ... he ... has natural forces ... these forces exist within him in the form of inclinations and capacities, in the form of attractions [tendencies]."[3] F. Engels shared the idea of materialist-enlighteners that "human nature is the product, on the one hand, of man's innate organization and, on the other hand, of conditions that surround man throughout his life and particularly during the period of his development."[4] In the current literature, there are also some convincing objections "to simplified conceptions of absence of any innate determinations of man's existence. Man is a social being, but at the same time he is a part of nature, and he is also a biological being" (P. N. Fedoseyev, 1976).

That inherited inclinations are necessary to the formation of consciousness is indicated, if only by the well-known fact that "rearing" a baby chimpanzee together with human babies does not result in socialization of the monkey (N. N. Ladygina-Kots, 1935). In order to become a member of society, it is not enough to merely live in a social environment; a specific, and high at that, level of biological organization of the individual as a whole and structural organization of his brain in particular are necessary also. If this level of biological organization does not exist, there cannot be development of a productive (social) being and personality (G. I. Tsaregorodtsev and A. F. Polis, 1968). The social condition for appearance of individual consciousness is social and substantive ["object-related," material] activity of man, his education and communication with others.

The Marxist principle of nature of man as the product of history also applies to individual development of the human mind. Here it is made more concrete, in particular with regard to the thesis that human capacities do not appear in a ready form from the time of birth, but are formed on the basis of inherited inclinations in the course of substantive activity, communication and education. "Man's capacity to think is formed by the logic of object-related practical activity, by learning about historically accumulated culture, through rearing and education, through object-related activity, by means of the procedures and tools created by society" (A. G. Spirkin, 1972).

Many Soviet psychologists (S. L. Rubinshteyn, B. M. Teplov, A. A. Smirnov, A. S. Prangishvili, Ye. V. Shorokhova, B. F. Lomov, N. A. Menchinskaya, K. K. Platonov, A. V. Brushlinskiy and others) are working on the following principle of determination of the psyche, which is the most adequate in our opinion: exogenous causes exert their influence by mediation through endogenous condition. Every action is interaction, and for this reason the influence of one phenomenon on another depends not only on the first, but also the second. At each stage of mental development, its exogenous and endogenous conditions interaction according to the principle of the external through the internal. With such interpretation of determination of mental phenomena, the eclectic theory of two factors is overcome, which recognizes the ranking of the external--social, and internal--biological. Human mental development is alwavs (particularly, from the time of birth) determined by external causes, continuously and from the very beginning interacting with the internal conditions of his activity (A. V. Brushlinskiy, 1977). The latter also include hereditary and/or inborn inclinations, which play a substantial (but not fatal) role in formation and development of man's capacities on the basis of his activities.

In the course of object-related and practical activities, there is reflection in a man's consciousness not only of the world around him, but these activities themselves, forming the logic of thinking. As indicated by V. I. Lenin, "human practice, which is repeated billions of times, is fixed in man's consciousness by logic figures."[5] Thus, the forms of thinking established historically in the course of substantive activity serve as a reflection of the logic of this activity, while the content of thinking is substantive reflection of surrounding reality (objective and subjective). Apparently, it can be stated that the formally logical aspect of thinking is established as a reflection of object-related activity, while the object-related meaningful aspect of thinking and consciousness serves as a reflection of the surrounding world. Object-related activity was of greatest significance in the course of historical appearance of human thinking from the animal psyche. In civilized society, the route of formation of logical thinking is shorter: each man does not simply acquire logical thinking as a reflection of substantive activity, rather he assimilates already existing logical forms in the course of education and communication.

In addition to the foregoing, we consider unjustified the thesis that the mental element is directly generated by external, practical activity, as exogenous actions move to the endogenous level. Indeed, as validly indicated by A. V. Brushlinskiy (1977), "the appearance of the mental element is not the result of such transformation, assimilation, etc., of exogenous, practical actions, because the latter contain, from the very beginning, at least the most elementary mental phenomena, which always regulate, afferentate and control them." In all instances of initial exclusion of endogenous (including innate) conditions of mental development of man, there is disappearance of all criteria of the mental aspect and elimination of psychological reality, which is dissolved in activity. Such a conception leads to derivation of the mental element only from exogenous conditions, which do not first interact with endogenous ones. Thus, already at the initial stage of development, exogenous conditions are severed from endogenous ones and as a result the mental element is severed from its direct carrier, the brain, and ultimately it is recognized that it is "man's activity that makes up the substance of his consciousness" (A. N. Leont'yev, 1975), rather than the neurodynamic systems of the brain. There is discussion here, in particular, of "comparing processes in the receptor system like the general basic mechanism of direct sensory reflection" (A. N. Leont'yev, 1965). Comparing the process making up the effector element of the receptor system also occurs in the function of some analyzers; however, this is mechanical comparison (for example, moving the hand over the outline of an object) that serves as one of the conditions of highly adequate sensory reflection, but is neither the cause of appearance of the mental element nor this mental element itself (N. I. Gubanov, 1979). Productive activity does not serve as the substance, the carrier of consciousness, but as the condition for its historical and individual inception, a factor in learning about surrounding reality and its adequate reflection in consciousness.

It is true and generally recognized that "exogenous," most elementary practical activity precedes theoretical activity, but it is not true that the mental element appears only as a result of its interiorization. Both of these types of activity, which are of utmost importance, occur always and at all stages thanks to mental regulation. Unlike a purely physiological reaction, every action is always regulated on the basis of mental (initially the most elementary) phenomena, without which it is simply impossible. For this reason, one should not think that first there is action and only then, on its basis, the mental element appears, as a result of its interiorization. Strictly speaking, the most elementary and genetically primary mental phenomenon probably appears even somewhat earlier than the first action. If this were not so, there would be no meaning to the assertion that exogenous action moves into the interior, since in such a case there could not be any "interior." Apparently, the phenomena that S. L. Rubinshteyn (1957) called "sensory impressions" are such primary mental phenomena, which appear at an individual's "first encounter" with the outside world. Sensory impressions, or mental modalities, are structureless elementary components of the psyche, from which sensations and more complex mental images (perceptions and conceptions) are formed. At all subsequent stages, the psychic element is formed and develops from the psyche in the course and under the influence of perceptive movements, productive activity, education and communication.

Interiorization per se is an undisputed and generally recognized fact, i.e., the transition of the psychic factor to a higher level of development, which is interpreted differently on the basis of two theories. According to one of them, interiorization theory, the psychic arises as a result of interiorization of an external action that gradually becomes internal. Ultimately, as we have already indicated, this theory leads to denial of the thesis that the neurodynamic systems of the brain are the direct code of the psyche. According to the other theory, worked out by S. L. Rubinshteyn and his disciples, the mental arises as a result of an external influence, with which starts the interaction between an individual and the outside world and which is immediately mediated by inclinations and other hereditary endogenous conditions. In our opinion, this theory makes it possible to concretely pose the question of the role of substantive activity in development of the human psyche. Proceeding from it, one can conclude that activity does not generate, but expressly forms, structures the mental element. As validly indicated by A. V. [illegible] (1968), "Mental thinking activity originates from practical activity, but it does so by means of development and refinement of the mental component always present in it, rather than by means of interiorization of a practical, [illegible] action." The mental emerges directly as a result of activation by [illegible] of the corresponding neurodynamic systems of the brain, which are [illegible] of its genetically determined structure.

[illegible] the existence of positive solutions in the course of the debates about the problem of capacities, we cannot fail to note that they are not infrequently too abstract. In particular, to solve more concretely the problem of the role of natural and social factors, heredity and upbringing in the inception of capacities, it is necessary to make use of several genetic concepts. Such concepts as "genotype" and "phenotype" are used by a number of authors in analyzing the [illegible] discussion; however, virtually no use is made of the concept of "reaction norm." Yet expressly this natural scientific concept plays a key role, in our opinion, in working out the problem we have touched upon.

[illegible], as we know, the aggregate of all genes determining the hereditary [illegible] (inclinations) of the organism, which man acquires from his parents. [illegible] of the genotype that is expressed by means of the environment in [illegible] characters, i.e., exogenous and endogenous structures and functions. The degree of expression of features is determined by the reaction norm, [illegible] the maximum range of changes in a given feature as a function of environmental conditions. The existence of a certain reaction norm [illegible] to adjust to changing environmental conditions by developing [illegible] (N. P. Dubinin, 1979). For example, the weight of the human [illegible] a specific range--within the range of the body weight reaction norm--[illegible] nutrition and life style. If we accept the fact that [illegible] are expressed on a certain neurophysiological basis, the structure of which is genetically determined, we must also accept the fact that the [illegible] of these functions is also referable to properties that have a reaction norm. We cannot agree with authors, for example, N. P. Dubinin (1979), [illegible] that the reaction norm exists only with regard to physiological functions and does not characterize mental functions. The concrete elements of [illegible] the human mind, which consist of information about the outside [illegible] that are not genetically determined. They are determined by the conditions under which the subject learns about the reality around him, i.e., the concrete information perceived by the subject, including that received via the channels of social succession. However, the volume of information that a subject can assimilate has its limits, since human memory, which is effected on a specific neurophysiological basis, is characterized by a genetically determined reaction norm. The operational aspect of thinking, intellectual capacity, ability to operate with information also has a reaction norm. The mental element corresponds isomorphically (one to one) to neurodynamic systems of the brain and constitutes their information content (D. I. Dubrovskiy, 1971). The mental capacity to reproduce reality is nothing other than the capacity of self-regulating neurodynamic systems to simulate this reality in their organization. Since the structure and capacities of neurodynamic systems are genetically determined, mental capacities also have a genetically determined reaction norm. As correctly observed by V. D. Timakov and N. P. Bochkov (1973), "man, like other biological species, has a genetically determined reaction norm, including the reaction norm inherent in component elements of mental activity. Recognition of this fact (since it cannot by any means be denied, for it has been proven already many times!) does not at all mean that there is underestimation of the enormous ... possibilities of education; on the contrary, it makes it possible to render the educational methods more goal-oriented."

Some of the properties of the human body do not have a reaction norm (or, more precisely, their reaction norm equals zero). They include, for example, blood group and color of eyes. Such rigidly determined characters do not have a changing degree of expression that depends on changes in exogenous conditions. If capacities for mental activity did not have a reaction norm, the degree of their expression would not depend on upbringing and education conditions. However, practice indicates the opposite. That human capacities have a reaction norm is indicated already by the fact that children, who were separated from society at an early age and grew up with animals differed considerably from normal children. They were incapable of human thinking, they did not speak and, after returning to live with people upon reaching a certain age could no longer learn to do this. These children could not develop independently, without communication with people, even the biped mode of walking, they moved about on all fours. A very definite conclusion ensues from this, that each man does indeed become a man, a social being, in the course of learning, productive-practical activity and communication, rather than by virtue of his high biological organization per se (V. I. Tsaregorodtsev and A. F. Polis, 1968). Outside the social environment there cannot be expression of the reaction norm of human mental activity. For this reason, we cannot agree that human capacities are only innate traits. Man does not inherit ready-made capacities, but only the possibility of their formation under appropriate social conditions, i.e., with inception (development) and exercising of mental functions. "Although the mental distinctions of man are not directly and fatally dependent on his inherited, innate distinctions, the latter are, so to speak, the potential possibility of formation of the individual" (A. G. Spirkin, 1972).

The foregoing indicates that external social causes per se, without interaction with endogenous genetic conditions, are utterly insufficient, though mandatory for normal mental development. Similarly, endogenous conditions alone, severed from interaction with exogenous factors, are not sufficient (with all their necessity) for successful development of the human psyche.

Man's inclinations will be determined by both the "genetically determined potential for development and anatomical-physiological ones, as well as mental distinctions, and the actual development of both (though to different degrees) depends on exogenous conditions, and for man this refers primarily to social ones" (K. K. Platonov, 1970). In the course of both anthropogenesis and individual development of man, the social element "emerges as a means of development of human nature, rather than a trait opposing the natural (even as the dominant one)" (K. A. Abul'khanova-Slavskaya, 1979). Using the genetic concept of "reaction norm," inclinations can be concretely defined as the reaction norm of the corresponding capacities. Then capacities are the expressed part of the reaction norm, the actualized part of the inclinations. In view of the foregoing, it would be correct, we believe, to formulate the problem as "heredity--upbringing": what are the maximum mental capacities (inclinations) of man determined by a reaction norm and to what extent are they expressed [realized] as a result of upbringing and education? As a corollary, one cannot consider correct the statement that the degree of capacities is entirely determined by social conditions. Heredity determines mental capabilities, while upbringing and education determine expression of these capacities to a given degree.

Proceeding from the thesis of absence of deliberate selection of mates in human populations, as well as the thesis of existence of a natural mutation process that is random in nature, it should be concluded that reaction norms, including those of mental functions and, in particular, the capacities of different people will fit in the curve of distribution of random values. This means that most people will have some average value of hereditary inclinations, while those with a greater or smaller value of these inclinations will be fewer and fewer in number as the distance from the average increases. None of us questions the fact that there is a certain statistical distribution of people according to height or weight, as well as all other somatic properties (physiological, biochemical, morphological parameters). A similar statistical distribution exists also for man's mental inclinations. The distribution of people according to magnitude of innate inclinations is confirmed by data to the effect that infants who are placed in children's homes immediately after birth and live there under identical conditions present the same diversity of intellectual capacities as all other children. Consequently, identical living, upbringing and education conditions do not equalize the intelligence of children having different hereditary inclinations, i.e., "the generally same social environment molds different human personalities" (A. G. Spirkin, 1972).

The foregoing does not, of course, mean that some nations may have a capacity reaction norm that is lower than others. Genetically, all nations are equal. Distribution of people according to genetic inclinations exists in both the entire human population as a whole and in different groups thereof, that are rather large, including nations.

However, there cannot be a pure expression of distribution of people according to magnitude of genetic inclinations. Depending on upbringing, education and conditions, the hereditary inclinations are realized to different degrees in different people. The fact that "the level of individual human thinking varies ... from the peaks of ingeniousness to remarkable primitivism" (A. G. Spirkin, 1972) is attributable to differences in natural and social determination of the psyche of different people.

Let us illustrate this with a hypothetical numerical example. Let us assume that the reaction norms for some capacity constitute 100, 90 and 70 arbitrary units for 3 people.[6] If these inclinations of theirs were fully realized their capacities would equal the cited numbers. Let us assume that the possibility was realized for each of them by 25, 30 and 40%. Then their actual capacities would constitute 25, 27 and 28 arbitrary units, respectively. Thus, the curve of distribution according to upbringing and education is superimposed on the curve of distribution according to magnitude of genetic inclinations. As a result, it is not necessarily the people who had higher hereditary inclinations that would also have better developed capacities. As indicated by B. F. Lomov, "there is no one-to-one link between inclinations and capacities. Similar capacities may be formed on the basis of inclinations that are different in structure and, conversely, different capacities can be formed on the basis of similar inclinations. Thus, the 'genetic equipment' of the individual, which is the prerequisite for capacities, does not predetermine their development unequivocally" (B. F. Lomov, 1976).

The existence of differences in magnitude of inclinations and capacities of people does not coincide with class, national and racial differences. The irreconcilable opposition between science and racism consists primarily of this basic lack of coincidence (A. V. Brushlinskiy, 1970, 1977). The Marxist-Leninist classics never said that all people are equal in their capacities. Marxism refers to social equality, not biological and psychological equality, and not equality of capacities. V. I. Lenin wrote: "... Different people belonging to the nobility are not equal in their physical and mental capacities, just as people belonging to ... the peasant class are not equal. But all noblemen are equal in their rights, while all peasants are equal in their denial of rights."[7] And: "... When socialists speak of equality, they always mean social equality, equality of social position, but by no means equality of physical and spiritual capacities of different persons."[8]

In antagonistic societies, the privileged classes always had better opportunities than other classes for expression of their hereditary inclinations. This served as grounds for them to speculate on the subject of supposedly innate deficiency of representatives of oppressed classes. Only a communist society creates really equal and maximum opportunities for its citizens to express all their inclinations and capacities.

At the present time, the structure of man's hereditary inclinations has not yet been established. It can be assumed that the same person has a more marked reaction norm with respect to some capacities and less marked with respect to others, i.e., he has an individual profile of giftedness. On the curve of distribution of inclinations of the human population, the same person will occupy different places, depending on which capacity is considered. For this reason, one can apparently discuss a person's greater or lesser giftedness only with regard to a concrete capacity.

Not enough work has been done either with respect to the mechanisms of transformation of inclinations into capacities, as well as classification of capacities. Various capacities (sensory, verbal, musical, design, etc.) require different environmental conditions and influences for their formation. K. K. Platonov (1970) has shown that formation of some personality traits requires only training, others require exercise, including feedback, others yet require education consisting of establishment of connections between what is newly learned and what has already been assimilated in the course of exercise and training. Apparently, sensory capacities (capacities for sensations) are the most easily formed, and they are overtly marked soon after birth. Other capacities are not formed so rapidly.

It should be assumed that the foregoing, with respect to capacities in general, also extends to intelligence, or thinking capacity proper. The latter differs from special knowledge, skills and abilities, and the study thereof under conditions of elevation of the role of creative labor is of paramount importance, as was justifiably noted by K. A. Slavskaya (1968). Human intelligence, like other capacities, is characterized by a certain genetically determined reaction norm, and the magnitude of this reaction norm in a human population presents a certain statistical distribution. However, the existence of a genetically determined reaction norm for intelligence does not mean that there is a preset limit to the capacities of a given person. The effectiveness of a man's activity and reaching his life goals are not determined by intelligence alone, but also by such factors as knowledge, will, work capacity, good organization, as well as objective living conditions.

With regard to the question of geniuses, it can be noted that the conditions for genius include both high hereditary inclinations and proper, optimum education and upbringing, which permit formation and development of capacities on their basis. Neither high genetic inclinations nor the best education alone, separated from one another will create a genius. Appearance of the latter is possible only if both factors are present--genetic and social. And we do not consider this to be a manifestation of "vulgar eclecticism": "one and the other," "on the one hand, on the other hand,'" as is presented, for example, by A. N. Leont'yev (1975).

In conclusion, let us mention that disclosure of concrete conditions and mechanisms of formation of hereditary inclinations in the course of anthropogenesis, conditions and means of maximum realization thereof and formation, on their basis, of capacities in the course of individual human development, elaboration of adequate methods for evaluating inclinations and capacities, determination on this basis of the profile of giftedness of an individual, development of practical educational methods to assure the fullest expression and development of inclinations and capacities of each person constitute the important tasks of future studies of natural and social determination of human capacities.

FOOTNOTES

1. Marx, K. and Engels, F., "Soch." [Works], 2d edition, Vol 23, p 188.

2. Such attempts are properly qualified, in our opinion, by K. K. Platonov (1970, p 142) as "neo-Helveticism."

3. Marx, K. and Engles, F., "Iz rannikh proizvedeniy" [From Early Works], Moscow, 1956, p 631.

4. Idem, "Soch.," 2d edition, Vol 19, p 198.

5. Lenin, V. I., "Poln. sobr. soch." [Complete Collection of Works], Vol 29, p 198.

6. The question of feasibility of quantitative evaluation of capacities is debatable. Proceeding from the thesis of inseparable dialetical link between quality and quantity, it should be considered that a positive answer is correct. Quality is always characterized by quantity, while the latter can, in principle, be learned and measured.

7. Lenin, V. I., "Poln. sobr. soch.," Vol 24, p 363.

8. Idem, Ibid, Vol 24, p 364.

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